Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY McGRAW PUBLISHING COMPANY, INC.

Volume 71 NEW YORK, SATURDAY, MARCH 6, 1915 Number 10

New Process to Order

THE shield method used in driving the Point Defiance tunnel, described in this journal last week, was literally a new process designed to order. Lack of space prevented comment last week on its special features. When the construction was planned, the absence of rock and of any great head of water led the contractor to promise rapid progress. After beginning work, however, it was found that the heavy soil pressure made progress by the timbering method slow and expensive. A new type of shield was then developed, which enabled the contractor to complete the tunnel in the required time and at a satisfactory cost. A shield was designed that covered only the roof and rested on the side-wall timbering which was placed in small advanced drifts. The tunnel, which is double track, contained a good sized excavation yardage, and the speed attained was due in no small part to the efficient handling of dirt at the heading, which the method allowed. All dirt was loaded by a steam shovel into dump cars. The material from the topheading, where the shield was being driven, and from the two side headings, where the wall timbering was being placed to support the shield, was fed to this shovel by motor driven belt conveyors. Thus, merely enough hand excavation was done to clear the advance work, and the main volume of excavation was handled mechanically.

A Constructive Series

ON page 301 of this issue is published the fifth article of Mr. Johnson's series on concrete; and with it, the constructive phase of his work, although in reality beginning with the demonstrations of the third article, on the importance of proper proportioning, becomes more evident. The concluding article of the series, dealing with the least understood and perhaps most important element in the making of concrete—the production of the binding substance, in other words hydration—will be published in next week's issue. Before this subject of hydration could intelligently be taken up in detail, however, there had to be a thorough understanding of the nature of concretes as they actually exist and of the underlying reasons for those limitations and defects. To this end old, isolated facts, known with that familiarity which breeds contempt, have been shown in a new light, and their intimate relationship established, not only to each other, but to new facts as well. The concluding article, in next week's issue, completing this necessarily brief summary of more than 4 yr. of investigation, cannot fail to bring conviction to any one who may have been disposed to question the statements of individual articles. Indeed, the more carefully the series is read in its entirety, the more significant it becomes; and if the lessons are applied and supplemental investigations are undertaken by those interested, to prove the applicability of the method to individual problems and needs, there should be improvement in the quality of concrete generally. The primary object of making public these researches at this time is to secure as widespread co-operation as possible in a careful study of field concretes. It is believed that the appeal will not fail of its purpose.

Status of Sewage Aeration

IT is not uncommon for those who undertake an investigation of a technical subject to begin at the very beginning, disregarding the work accomplished by other experimenters. The highway field is rich in examples of this practice, and for a while the building of experimental roads had developed almost into a fad. When certain principles have been established it is a waste of time to prove them again. It is evident from Leslie C. Frank's preliminary article on the proposed tests of sewage aeration at Baltimore, on page 288, that the work already done in England will not be disregarded and that an effort will be made, not merely to verify the conclusions of other investigators, but to advance into new fields of research. The Manchester results, as reviewed by Ardern, are based upon what may be termed the draw-and-fill method of operating the aeration tank. At Baltimore an attempt will be made to employ the activated-sludge principle in a continuous flow tank—something which has not been done successfully heretofore. In following the work at Baltimore it is of the greatest importance to know just what has been accomplished at other places, and it is for this reason that Mr. Frank's introductory article, giving a concise summary of English experiences with activated sludge, is valuable, for it gives the necessary basis from which to judge the results of the near future.

Bulk Cement on Small Jobs

LESS than three carloads of cement went into the foundations for additions to a grain elevator in Minneapolis last fall; still the contractor ordered bulk cement. He employed practically no special equipment to unload it, no elaborate storage bins and no delicate means of measuring the cement into the mixer. As noted in the account on page 309, a corrugated-iron storage shed was constructed similar to one used previously for sacked cement. A tarpaulin over the top was thrown back from a small area only while the cement was being unloaded. Once in the pile the cement was treated exactly as was the aggregate. Certain wheelers detailed to handle cement, measured it into their barrows with a tub and then fell into line behind the men with the sand and stone. There is no more dust, the contractor testifies, in bulk cement than that which comes from dropping, emptying and shaking sacks. Less confusion occurs at the mixer, 7 to 12 cents per barrel are saved, and no loss is sustained from a leaky hose playing on the sack pile. The Engineering Record has been waiting to hear of some contractor with sufficient ingenuity to work out the handling of bulk cement on a road contract. This comparatively small piece of work in Minneapolis points the way, in part at least. On page 152 of the issue of Jan. 30 was noted an Oregon road-building plant where materials, including the cement, were hauled to the site, all properly proportioned. The Oregon storage plant was on a bridge and aggregates came to it by boat and were handled by a derrick to the bins. If the delivery had been by car bulk cement would have been entirely feasible, and there is good reason, therefore, to expect its application to road work in the near future.

Organized Enthusiasm

AS a magnet to draw a large attendance of engineers at an annual convention, the usual "banquet" is steadily losing strength. To many men, especially those who have been present at annual meetings of technical organizations for years past, the progress through soup and fish to coffee and oratory has become a decided bore. But the committee on arrangements at any convention must prepare a program of entertainment, and the banquet always offers an easy solution of the problem. It has remained for the Western Society of Engineers to enliven the routine of the annual dinner and to double the attendance at it by a careful organized campaign of "boosting." So many other organizations are confronted with the task of stimulating the interest of their members at annual meetings that the methods of the Western Society, as outlined on page 304, are well worth studying. In the first place it was realized that a large attendance could not be secured through the efforts of one or two men. A "boosters' committee," therefore, was formed and to each of its members was assigned a list of those for whose presence at the dinner he was responsible. Appeals by mail were supplemented by telephone requests and the whole campaign was made on the basis of the personal appeal. The result was the presence of 400 men instead of the usual 200. Several novel features were introduced at the Chicago dinner. The idea was to banish formality and induce an atmosphere of good-fellowship.

A number of "stunts" had been arranged following, in a lesser way, the procedure which has made the "Gridiron" and "Evening Star" dinners at Washington famous. Thus the Chicago dinner was different from the usual function of this sort and its success is a demonstration of what can be done by organizing the enthusiasm.

Lumber Interests Aroused

LAST week there was held in Chicago a lumbermen's mass meeting, called by the Forest Products Federation, which brought together timber producers and lumber dealers. The chief topics for discussion were the inroads which other building materials have made upon timber and plans for restoring this material to its proper place in engineering and building construction. The standing of the men behind the publicity, vigilance and educational movement started, which is to be carried on as a "department of trade extension," within the National Lumber Manufacturers' Association, gives assurance that the plan for spending $1,000,000 on the work during the next five years will be carried through. The new organization will start work as soon as $50,000 has been subscribed, and the spirit of the meeting indicated that this sum will quickly be in hand.

This awakening of the lumber interests is akin to that of the gas industry some years ago. It will be remembered that the electrical interests had carried on with remarkable success a sweeping educational campaign on the advantages of electricity for lighting. Not only that, but they had successfully invaded the heating field with small apparatus, such as toasters, coffee pots, etc. Meanwhile the gas interests did not bestir themselves. They failed to take advantage of the great developments made by the Welsbach burner, but only after the most serious inroads into their business by the electrical interests did they awaken to the necessity of employing equally strenuous promotion methods.

In building materials the history has been somewhat the same. Cement and hollow-tile manufacturers, alive to the value of various advertising and educational media and schemes, used them to excellent advantage and impressed upon the popular mind the need for a "fireproof" material. Wood burns, was the argument, and therefore should be replaced by an unburnable and, by implication, fireproof construction. The result has been that less and less lumber has been used for structural purposes, while the discrediting of timber has caused its exclusion for many uses by building codes and put it under suspicion with people generally. As is well known to all engineers, there is an excellent field for timber construction in both engineering and building work. For the latter purposes, if buildings are properly sprinklered, the fireproof argument against them falls to the ground. Without a doubt owners can, in certain cases where timber is adaptable, save money by its use and secure a construction safe and satisfactory for their purposes.

It will be the object of the educational campaign to be inaugurated by the lumber interest to restore lumber to its proper place, not only to hold for it its present market but regain as largely as possible the legitimate fields which have been lost.

Ohio's Opportunity

ON account of her great disaster, Dayton, somewhat less than two years ago, occupied for a time the center of the world's stage. Following close upon expressions of sympathy came commendation for the energetic relief measures of its own citizens, for its subscription of $2,000,000 for flood prevention study, for its employment of a competent engineering corps to prepare the necessary preventive plans and, after some months, for its successful efforts to get through the Ohio Legislature an act which would enable not only the Miami Valley, but other flood-beset regions of the State, to build economically the necessary flood-protection work. Remarkable, indeed, was the activity displayed by the residents of the valley and there were high hopes that the necessary works would be undertaken just as soon as the engineers had concluded the details. Momentous, it appeared at the time, was the first session of the Conservancy Court at Dayton, a year, almost to a day, after the great disaster. The scene will not soon be forgotten by those who were privileged to attend. On a long platform sat ten judges of the Court of Common Pleas, one from each of the counties which would be represented in the Miami conservancy district. Before them were table after table for counsel representing the various interests affected, and then in sweeping semi-circles those who had borne an active part in pushing the Dayton relief and flood-prevention work. Back of them, filling all the available main-floor space and even overflowing into the gallery of the great hall which had temporarily been transformed into a court room, were the plain people of the valley, those who knew by actual suffering what a flood visitation meant. Their faces showed that to them the proceedings were all-important.

But the progress, up to that point so rapid and auspicious, at that stage struck the first snag, and since then a clever, determined, but wholly misguided and unreasoning propaganda has delayed the work, so that to-day it is hardly nearer realization than it was when Governor Cox signed the Conservancy Act early in 1914. Nay, more, due to the astounding shortsightedness of certain communities, and the selfish sacrificing of the general good to local interest, the future, if anything, is a bit darker now than it was a year ago.

The trouble started at the first meeting of the Conservancy Court, above referred to. The constitutionality of the act was questioned, and bitterly fought proceedings have not yet resulted in a final decision of the ultimate court. Meanwhile the opposition's propaganda goes on and every effort is made to enlarge upon the fancied dangers of reservoirs and to strengthen the prejudices of those whose lands would be overflowed. Competent advice, secured by the Dayton Citizens' Flood Relief Committee, has been totally disregarded in the upper valley, and in opposition thereto no effort has been made to adduce the testimony of equally competent engineering authorities in support of the levee method of prevention, claimed by the opponents of the Dayton scheme to be adequate. Furthermore, the provisions for adequate compensation to those whose lands would be taken seem to be disregarded in the blind fury which has followed upon the agitation of those who predict another Johnstown disaster if the reservoir system is built. Not content, too, with legal attack, the opponents have carried their fight into the Legislature and have secured the introduction of two bills, amending and emasculating the Vonderheide, or conservancy act. These bills would kill the law by depriving the court of control in certain respects over the directors and appraisers, now a feature of the conservancy law, by delaying the progress of the work and forbidding absolutely the construction of detention basins. The legislators, at the start, may be expected to share the prejudices of their constituents, but their qualifications as leaders make it reasonable to expect that they will listen with open minds to the arguments for and against the amending measures and reach their decision upon the weight of evidence and upon what is best for the general good rather than what is of local advantage.

Ohio stands to-day in an anomalous position before the country. Her disaster attracted attention from coast to coast, and great has been the commendation for the energy she displayed in her rehabilitation and in her steps to protect herself from similar visitations. What credit was gained, however, has been more than counterbalanced by the shortsightedness of the opposition, by the refusal of some of her citizens to come to their neighbors' relief, and by their determination to insist upon their method of flood protection in the face of the reports of engineers most competent to advise on the subject.

Ohio can redeem herself, but only by dropping her narrow partisanship and by displaying sympathy for those who have passed through one disaster and are determined to save them and other parts of the State from similar devastation in the future. It is not too much to expect the legislators of Ohio to defeat these iniquitous measures. Anything less will bring upon the State a censure which will be fully deserved.

Indiana, it may be noted, slower than Ohio it is true, has risen to the occasion and there is likelihood of a bill similar to the Vonderheide act, now before the general assembly of Indiana, becoming law. The machinery of the proposed Indiana act differs somewhat from that of Ohio but in its broad features it resembles the earlier statute, and demonstrates that the sister State, after careful study, believes the Ohio statute adequate for the purposes to be accomplished.

Subsidizing the Unions Through the Alien Labor Law

THE immediate result of the New York State Court of Appeal's decision affirming the constitutionality of the so-called Alien Labor Law, which excludes all others than American citizens from participation in the construction of the State's public works, has been the discharge of thousands of workers on the New York subways and the halting of progress on contracts involving over one hundred millions of dollars. This, however, is but a forerunner of the trouble that will eventually ensue unless the law is repealed by the Legislature or declared unconstitutional by the United States Supreme Court. The operations on the Barge Canal are involved in precisely the same way, to say nothing of the construction program of the State highway department and other State projects. Even a repeal by the Legislature would leave unsettled the matter of declaring the subway contracts void by reason of foreign labor having already been employed in violation of the law. To be effective the repeal measure would have to carry some provision for validating the contracts which have automatically become invalidated by the contractors' violation of the existing labor clauses.

The basis upon which the law is upheld is thus stated by Judge Cardozo in the decision of the Court of Appeals: "The moneys of the State belong to the State. They do not belong to aliens. The State, through its Legislature, has given notice to its agents that in building its public works it wishes its own moneys to be paid to its own citizens and, if not to them, then at least to the citizens of the United States. * * * The equal protection of the laws is due to aliens as to citizens, but equal protection does not mean that those who have no interest in the common property of the State must share in that property on the same terms as those who have an interest. * * * We do not assume to pass judgment on the wisdom of the Legislature. Our duty is done when we ascertain that it has kept within its power. The statute does not hold from the alien the rights secured to him by the Constitution and we must therefore enforce it as the law."

There are two possibilities of relief in sight—the repeal of the law by the State Legislature or a reversal of the State Court's decision by the United States Supreme Court. Under the present conditions there are placed upon the State, in the construction of its public works, restrictions which apply to no private employer of labor. By employing none but citizens the State must pay for its construction at rates greatly in excess of those of private interests. It seems reasonable to assume, therefore, that, especially in the present financial conditions, new work will be greatly curtailed, if not actually discontinued, so that instead of there being a greater field for citizen labor on public works there will be no field at all. The unions, apparently, think differently. However, if the law is enforced the extra price will come from the pockets of the tax-payer and the State will be obliged to employ a restricted class of workers.

There is but one interpretation of this result—the State will be compelled to do nothing more or less than subsidize the labor unions under the guise of fostering public welfare. The sad part of the whole situation is that the matter was not brought to a head before so important a program as the subway work had been begun. Still there may have been reasons for keeping the law on the books. Its possibilities as a club to swing over the head of any contractor who might not be living strictly within its provisions, are apparent to any politician.

It appears that the contentions of the union leaders that a plentiful supply of citizen labor is available to take the places of the foreigners on the subway work are not concurred in by the contractors. While in numbers the applicants may be adequate, in quality and fitness for the tasks to be performed most of them thus far have fallen far short of the minimum standard. Then, too, those that are physically qualified would require long training before they could be entrusted with such work as shoring and timbering. Even if enough citizens could be secured and paid the higher scale of wages the contractors' forces would be demoralized almost indefinitely and the increased transit facilities, which are urgently needed, would be postponed beyond the dates set for completion. If the issue is to be decided on the grounds of public welfare, the alien labor law has no place in the control of employees on public works.

Deferring to the Teachers

SEVEN years ago the American Society of Civil Engineers appointed a special committee on engineering education. Admittedly the subject is a large one, or can be made large, but in seven years it should have been possible to reach conclusions on at least some phases of the subject. Instead there have been only promises—promises that ended this year in a statement that the committee had best do nothing of its own accord, but co-operate with the Carnegie Foundation for the Advancement of Teaching, which is carrying on an investigation of the subject. In other words, the society—a body of practitioners, presumably competent to state the qualification needed for engineering work, if not the courses by which the needed training shall be given—defers to the report of a teacher, a teacher not of engineering but of pure science.

In this there is no criticism of the Carnegie Foundation. It is entirely within its scope to investigate engineering education, while, furthermore, its present investigation was undertaken largely upon the suggestion of committees of various engineering societies. This report, however, will not be that of engineers, and the Engineering Record believes that the national societies will not be content to accept it, but will insist that they have a report of their own.

The foundation proposes not merely to investigate actual courses of instruction but also to gather opinions from the field as to the adequacy of present engineering instruction, and to attempt to connect curricula and methods of instruction with the efficiency of the product—the technical graduate. Apparently the work has been well planned, and the data collected from the field should be of immensely greater value than that collected in the colleges. Even then, however, the conclusions drawn from the field data will be from the insider's, that is, the college man's point of view, and not from that of the practitioner. This alone would make it necessary for the societies to draw their own conclusions, for the views that will have weight with their members will necessarily be those of practising engineers and not of prejudiced parties, the teachers, who are responsible for engineering education as we know it today.

There is reason, therefore, for activity on the part of the special committee of the American Society of Civil Engineers. Its delay, it has been explained, has been due to the difficulty and cost of collecting what the committee has considered are the necessary data. Undoubtedly a collection of data on the subject, if thoroughly digested, will throw light on the whole problem, but it is possible, without devoting the time of a special investigator to the subject, to lay down certain broad principles. If, as now seems certain, the drift toward "practical" instruction seems to be slackening and the old definition of education—to draw out, to develop latent talents—is again coming into favor, there is a greater need than ever for a succinct and vigorous statement of these principles. Even if the committee takes the Carnegie Foundation's report as the basis upon which to rest its own conclusions, it will have to formulate these principles, which are virtually the ideals of engineering education. Moreover, that work had best be done when the minds of the members of the committee are free, unhampered by the bias which it is but reasonable to expect in the foundation's report. That report should be studied by all means. Whatever of value it adduces should be tested by the principles which the society's committee should lay down, but fundamentally the committee should and must stand on its own feet; anything less will not be compatible with the dignity of the American Society of Civil Engineers.

Furthermore, the investigation of the foundation is progressing at a goodly rate. There is need, therefore, for prompt action, and since the committee has, without result, had seven years in which to attack its problem, it is proper now to call into play the machinery instituted recently for the government of technical committees. The invocation of that machinery, too, would be in harmony with the recently awakened activities of all committees of the society. Heretofore, they have been allowed to drift as they willed, but the board of direction has now spoken and has indicated that it will hold them to strict accountability for their assignments. The matter is an important one, and it is high time that it be placed in the hands of an active committee.

English Experiments on Sewage Aeration Reviewed as Preliminary to Baltimore Tests

Features of Activated Sludge Process at Manchester and Salford Enumerated—Continuous-Flow Tank Will Supersede Draw-and-Fill Methods

By LESLIE C. FRANK
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As announced in the Engineering Record of Feb. 20 the U. S. Public Health Service and the Baltimore Sewerage Commission have begun a series of experiments on sewage aeration at Baltimore. One of the Imhoff tanks at the Back River treatment works is being remodeled so that it may be used for the tests. Most of the work done by English investigators has been on the draw-and-fill method. The feature of the Baltimore experiments will be the testing of the activated sludge principle in a continuous flow tank. This article, summarizing the results accomplished in England, is an introduction to one which will describe the new aero tank in detail and outline the schedule of experiments proposed. —EDITOR.

IN December, 1914, my attention was directed by a letter received from H. C. McRae, division engineer of the Baltimore Sewerage Commission, to several interesting articles which had appeared in the English engineering press. These articles dealt with what appears to be an entirely new principle in sewage treatment, namely, the principle of "activated sludge." It will be pertinent to discuss briefly the substance of these articles.

ENGLISH ACTIVATED SLUDGE EXPERIMENTS

In Manchester, England, in 1913, Edward Ardern and W. T. Lockett began a long series of experiments attempting to apply aeration methods in the purification of sewage. These experiments showed startling results. It was found at first that in order to nitrify completely an average sample of Manchester sewage it was necessary to apply continuous aeration for five weeks. It was due to experiences similar to this that many investigators in the past have given up the idea of tank aeration as being much beyond the economic limit. However, Ardern and Lockett allowed the sludge remaining after this five weeks' aeration to settle out, decanted the purified sewage and replaced it by a further sample of crude sewage. Nitrification of this second portion of sewage mixed with the previously oxidized sludge resulted in a shorter period of aeration. Encouraged by this discovery the experimenters continued accumulating a larger amount of oxidized sludge and finally became convinced that the presence of such accumulation of sludge deposit resulting from prolonged aeration "had the property of enormously increasing the purification effected by the simple aeration of sewage." It was established that a well nitrified effluent could be obtained by 6 hr. aeration of Manchester sewage "in intimate contact with one-fourth its volume of activated sludge." The air in these laboratory experiments was blown through plain pipes and under these conditions it was necessary, between the doses of sewage, to subject the activated sludge to a further intermediate period of aeration.

Ardern and Lockett were sufficiently encouraged by the results of these laboratory experiments to consider advisable the carrying out of a larger scale outdoor experiments at Manchester. (Ardern and Lockett, Journal Society of Chemical Industry, No. 23, Vol. 33, 1914). These experiments gave even better results than those obtained in the laboratory previously. It is believed that this was because of the use of a different method of applying the air. The experiments were carried out in casks of 50 gal. capacity and the air was applied through porous tile placed in the bottom of the cask. One volume of activated sludge to four volumes of crude sewage aerated for a period of 4 to 6 hr. with about 15 cu. ft. of air per square foot of tank area per hour with a subsequent sedimentation period of 1 to 2 hr. prior to decantation gave the results in the accompanying table.

RESULTS OF MANCHESTER AERATION EXPERIMENTS,
Parts Per Million

Six Hours Aeration Temp. 16 to 22 Deg. Fahr.

	Raw Sewage	Effluent
4 hr. oxy. abs.	102.2	8.6
Free ammonia (saline)	35.6	3.2
Albuminoid ammonia	10.3	0.8
Nitrite (NH_3)	...	0.6
Nitrate (NH_3)	...	18.7
Absorp. of dis. oxy. 5 da. 65 deg. Fahr.	...	8.0

Four Hours Aeration Temp. 15 to 20 Deg. Fahr.

	Raw Sewage	Effluent
4 hr. oxy. abs.	102.3	10.3
Free ammonia (saline)	34.6	2.1
Albuminoid ammonia	9.9	1.0
Nitrite (NH_3)	...	0.7
Nitrate (NH_3)	...	16.0
Absorp. of dis. oxy. 5 da. 65 deg. Fahr.	...	...

The results in these tables are sufficiently significant. Certainly the nitrification produced by even the lower period of 4 hr. aeration is ample to assure a thoroughly stable effluent.

SALFORD TESTS

Somewhat later Melling and Duckworth of the Salford River Conservancy Committee extended the activated sludge experiments to a larger outdoor scale at Salford, England. There were already existing at the Salford plant six roughing filters, 18,000 sq. ft. in area, filled to a depth of 2 ft. 6 in. with river gravel, and equipped with a network of air pipes with ½ in. brass jets, each filter having about 15,000 jets. One-third of one filter, or 1000 sq. ft. with 5,000 jets, was converted for aeration purposes by removing the river gravel and building a brick wall close to the air pipes so as to obviate stagnation of sludge below the pipes. For the first experiments only half of this converted section was used, approximating a tank of 12,500 gal. capacity. This tank was operated about one month on the gradual-sludge-accumulation basis of the previous laboratory experiments, i.e., the tank was filled with crude sewage and aerated for a few days, then the sewage was allowed to settle several hours and drawn off, and finally a new charge introduced. At the end of this first month of operation it was decided to accelerate the accumulation of activated sludge and some washed final effluent humus was added to the tank and the aeration continued for another month without replacements of sewage. At this time fillings were recommenced with a 3-hr. aeration period and a 2-hr. settling period. The average results are given in the table.

RESULTS OF SALFORD AERATION EXPERIMENTS
Parts Per Million

Three Hours Aeration; Temp. 19 Deg. Fahr.

	Settled Raw Sewage	Effluent	Per Cent Reduction
4 hr. oxy. abs.	71.1	7.50	90
Free saline ammonia	28.6	0.1	..
Albuminoid ammonia	5.3	1.3	76
Nitrite + nitrate as N.	1.0	11.1	..
Dis. oxy. abs. 5 days at 65 deg. Fahr.	..	4.6	..

Some separate tests were also made on dissolved oxygen consumed in 5 days at 65 deg. Fahr. for a period of aeration of only 1 hr. Following are three random results quoted by Mr. Duckworth:

DISSOLVED OXYGEN CONSUMED SALFORD AERATION EXPERIMENTS
Parts Per Million

One Hour Aeration; Temp. 19 Deg. Fahr.

1914	Crude Sewage	Effluent	Per Cent Reduced
Oct. 12	83.0	18.3	78.0
Oct. 13	110.0	18.0	85.8
Oct. 16	87.0	14.5	83.3

The Salford experiments demonstrate the feasibility of translating on the fill-and-draw plan the activated sludge process to a large out-of-door scale, and give a definite confirmation of the previous laboratory small scale experiments.

PROPERTIES OF ACTIVATED SLUDGE

Ardern states that the sludge obtained from the activated sludge process differs entirely from the usual tank sludge. It is inoffensive and flocculent in character. The percentage of moisture is high, about 95 per cent, but it is stated that the sludge readily separates from its water content by treatment upon fine grade filters, resulting in a sludge of the consistency of stiff jelly. Duckworth states that the activated sludge obtained at Salford contains *three times as much nitrogen, twice as much phosphoric acid, and one-half as much fatty matter as ordinary tank sludge.* If these results can be obtained on a practical engineering scale the question of the fertilizer value of sewage sludge would again be raised with new force.

Herewith are some analyses of activated sludge quoted by Ardern:

ANALYSES OF DRY ACTIVATED SLUDGE IN PER CENT

	Manchester	Salford
Organic matter	64.7	54.5
Mineral matter	35.3	45.5
Total nitrogen	4.6	3.75
Total organic matter nitrogen	7.1	6.9
Phosphate (P_2O_5)	2.6	2.1
Extractible matter (grease, coloring matter, etc.)	5.8	4.8

REVIEW OF MANCHESTER RESULTS

Ardern, in reviewing the Manchester results, enumerates the following important features of the activated sludge process:

(1) For complete nitrification with a reasonable aeration period a considerable portion of activated sludge should be employed, probably not less than one volume of sludge to four volumes of sewage. Well clarified effluents, showing a high percentage purification may be, however, obtained with relatively much less sludge.

(2) It is essential that there should be intimate mixture of the activated sludge and sewage. It is therefore highly important that adequate means should be adopted for the removal of road detritus, grit, etc., from the sewage. Otherwise there will be a tendency to form deposits on the floor of the aeration tank. Under such conditions not only is a proportion of the active sludge removed from the sphere of action, but the accumulated banks of sludge are liable to give rise to certain secondary reactions inimical to the complete success of the oxidation process.

(3) Temperature is an important factor in the success of the aeration process. The purification is seriously diminished at temperatures constantly below 10 deg. C. Above this temperature satisfactory results can be maintained. It is advantageous, however, if a temperature approaching 20 deg. C. can be maintained as under these conditions nitrification is greatly facilitated. In this connection it must be remembered that the Manchester and Salford results given previously were obtained during the summer and autumn months with entirely favorable conditions. In the majority of these cases maintenance of these excellent results during the winter months would doubtless require that the temperature of the sewage should be raised slightly by the use of warm air or by other means.

(4) It is necessary, in order that nitrification should proceed without hindrance, that the alkalinity or basicity of the sewage should be sufficient to account for the nitric acid resulting from the nitrification of the ammonium salts. When employing a proportion of one volume of activated sludge to four volumes of sewage no difficulty has, however, arisen in this respect either at Manchester or Salford.

(5) The oxidation process is essentially biological and consequent care will have to be exercised when dealing with a sewage liable to contain excessive quantities of inhibitive trade effluents, especially as complete success is dependent upon the maintenance of the activity of the nitrifying organisms, which, unless thoroughly established, are very susceptible to adverse conditions.

Ardern finally makes note of the fact that all of the results described have been obtained by working aeration tanks on what may be termed the fill-and-draw method. "Experiments carried out on a continuous flow system have so far not met with the same success on account of certain engineering difficulties which obtain. Satisfactory progress with these methods of working is dependent on the design of a tank in which these difficulties may be overcome."

THE AERO TANK

The writer has designed a form of tank which he believes will enable the activated sludge process to be applied to the continuous flow system. He proposed this type of tank to Prof. Earle B. Phelps and through him to the Surgeon General of the United States Public Health Service, with the suggestion that, since the Imhoff tanks now nearing completion at Baltimore were of such design that one or more of them could easily be converted for the necessary experiments, it would be advisable to propose joint experiments with the Baltimore Sewerage Commission. This suggestion resulted in a letter of proposal from the director of the Hygienic Laboratory to Calvin W. Hendrick, chief engineer of the Baltimore Sewerage Commission. Mr. Hendrick agreed to the joint experiments.

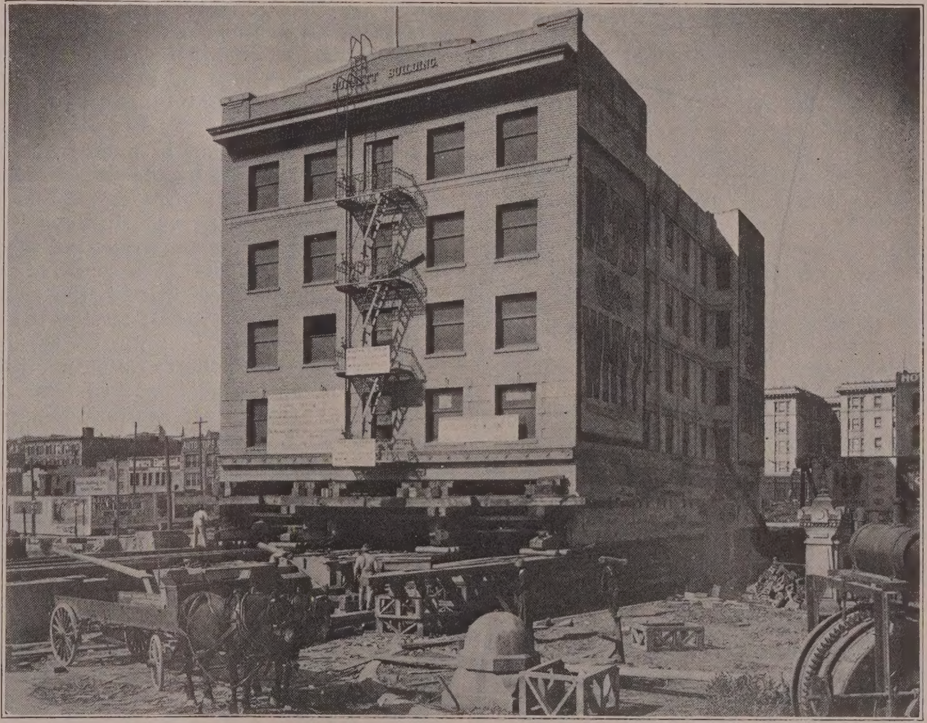
The second instalment of this article will describe the proposed aero tank and the proposed schedule of experiments to be conducted at Baltimore.

Moving Reinforced-Concrete Hotel in San Francisco

Path up Heavy Grades and Around Various Obstacles Is Worked Out on Paper by a Series of Computed Curves

By A. D. PHARES
Engineer in Charge for William Bruce, San Francisco

IN clearing the large area in San Francisco to be occupied by the group of buildings and surrounding grounds known as the Civic Center, among the buildings to be removed was a reinforced-concrete hotel. It was taken for granted that it would have to be wrecked. The Board of Works awarded the contract to William Bruce, a general contractor of this city, on his bid of $1736; he to receive that sum in addition to the proceeds of the wrecking. It seemed almost wanton to destroy such a structure, as it was but newly completed and had never been occupied. Mr. Bruce had very different ideas, however, with the courage to put them to the test. He carried the building off whole.



THIS BUILDING WAS MOVED TO MAKE ROOM FOR SAN FRANCISCO'S CIVIC CENTER

SIZE OF BUILDING

The building is 50 x 95 ft., with five stories and a basement. The material used in it was Mt. Diable cement—a local product meeting the requirements of the American Society for Testing Materials—beach sand and wash gravel in about a 1:6 mix. Each of the side walls contains ten columns, each reinforced by four 1-in. twisted bars. The panels between are 6 in. thick, reinforced with $\frac{3}{8}$-in. twisted bars. The vertical steel is 12 in. between centers; the horizontal, 18 in. Above the first story the continuity of the walls is broken on each side by a 6 x 60-ft. light well. The rear wall is of similar construction, containing three panels. The front wall is much heavier, the panels being 16 in. thick and made of brick, the entire front being faced with pressed brick. On each floor the side walls are tied by ten 12 x 12-in. reinforced-concrete girders, running transversely between the columns.

PLAN OF ACTION

Mr. Bruce's plan of loading the building was as follows: He removed the ground floor entirely, and, beginning at the floor of the basement, blocked up to the level of the street for the foundation of the tracks, which were four in number.

The tracks were of heavy timber with a surface of 2-in. maple planks. On the tracks rested rollers 4 ft. long and 8 in. in diameter, made of laurel. Resting on the rollers were the shoes. These were of the rocking type, 12 in. x 14 in. x 8 ft. pine faced with 2-in. maple planks; the ends were rounded up, toboggan fashion, in order to take and leave the rollers easily. The upper bearing surface was about 2 ft. long, which permitted considerable flexibility of movement, both horizontal and vertical.

The four shoes carrying the front were 12 ft. long to take care of extra weight. There were ten shoes to each track—a shoe under each of the ten columns. Above these were the spring timbers, 12 x 14 in., running the entire length of the building. Resting on these, over each shoe, were 6 x 8-in. transverse tie beams. On these lay four pair of 12 x 12-in. timbers running the entire length of the building. These in turn carried ten pairs of 12 x 12-in. transverse timbers which pierced the outer walls on each side of the columns and carried the walls and columns. On these rested four 12 x 12-in. longitudinal timbers which caught all the girders of the second floor. This grill formed the platform, or sled, upon which the building was carried. It will be seen that the weight was carried as it was built—the greater load being at the outer walls.

The timbers having been placed in position, steps were taken to prevent settling when the weight of the building was transferred to the tracks. Hardwood wedges were driven with sledges between the sled and the building and between the sled and the shoes; so tightly were they driven that the building was actually raised ⅛ in. when released from the foundation, due to the compression of the timbers and blocking. When all the timbers were wedged to a firm bearing the walls were cut through by pneumatic drills, the reinforcing steel was severed by oxy-hydrogen torches and the building was ready to start on its way.

HAULING EQUIPMENT

The hauling equipment consisted of a 50-hp double-spooled donkey engine which pulled upon a ¾-in. cable, rated at 23 tons, running through four pairs of 16-in. sheaves. This tackle pulled as a luff on the main cable, which was ⅞ in., rated at 27 tons. The main cable ran through four pairs of double blocks fitted with 18-in. sheaves. This pulled on the eveners, which were made fast to the far end of the spring timbers. The pull being thus applied at the rear of the building, it was virtually pushed instead of pulled. This avoided the danger of pulling the platform apart. As part of the route was up a steep incline, an auxiliary engine with an independent system of pulleys was made fast to the corners to prevent the building running back down the incline in case of breakage in the main rigging. This auxiliary tackle was kept under comparatively low tension.

When the first pull was made a surprise was given the house movers. The building had been cemented to its neighbor on the east through a long gap in the lining boards. When they let go, which they did with a snap, it was found that about 40 sq. ft. of cement and 55 bricks had been sheared off, leaving about ¼ in. of the brick adhering to the moving building.

The first run was 110 ft. up a 3½-per cent grade to the first turn. When moving up the inclines the building remained level, blocking being placed between the spring timbers and the shoes to fill the triangle between the incline of tracks and the level spring timbers. At the end of the first run the building was blocked up, the straight tracks were removed and circular tracks, forming a turntable, were substituted. The center was 7 ft. 6 in. east of the westerly wall and midway of the length. Mr. Bruce determined this point by trial on a large-scale drawing, it being necessary to clear the building on either side and the car tracks ahead.

In turning, an engine was placed at each end, pulling tangent to the track. After turning about 45 deg. the turntable was removed and a straight-away inclined track substituted. The turning required several weeks, as it involved an immense amount of work under exceedingly adverse conditions.

CURVED PATH TO AVOID OBSTRUCTIONS

At this point I, who had been an interested spectator while passing daily, suggested to Mr. Bruce the advantage of making the next turn and the detours necessary to avoid the various obstacles by a series of curves. After several conferences he determined to try it and I was employed as engineer, or as he sometimes humorously styled it, "special pilot," which, in view of the devious route followed, seemed quite applicable.

Two intersecting base lines, being respectively the prolongations of the side of the building as it then stood and as it would be in its final position, were laid out with a transit and all the obstructions, good and bad ground, etc., were carefully located with reference to them. A route was then chosen that would avoid the obstacles and take advantage of the favorable ground. The next run was 295 ft. up a 2.4-per cent grade on a 1725-ft. curve to the left to clear the corner of the massive foundation of the old City Hall, which had been destroyed by the fire in 1906 and had later been razed as far as the foundation. The center line of each of the four tracks was painted on the pavement, walks, etc., and grades were applied at intervals of 20 ft. The corner of the foundation having been passed, the curve was reversed to one of 1525-ft. radius to the right, the building still being on the inclined track. When the elevation required to clear the old foundations had been attained, the inclined tracks were removed and level tracks substituted.

A DIFFICULT TURN

The heavy foundation of the old rotunda, which was higher than that of the main building, stood directly on line and but 70 ft. distant. This necessitated an exceedingly sharp turn to the right. The first portion of the curve was of 206-ft. radius with the center on line with the rear wall. Locating the center in this manner caused the front to swing very rapidly, as was needed to clear the rotunda. There being no precedent to guide us, questions arose as to the performance of the building. Would the building follow the tracks? Would it do so without straining itself? How could the rollers be centered so that each roller would be working in unison with the others and no racking would result? The center was on the other side of a brick building, so that the rollers could not be sighted in to the center as is commonly done in the turntable method. The centering was easily accomplished by stretching strips from one spring timber to the other at calculated points. The rollers were then sledged parallel with these converging strings. By this means the several hundred rollers were made to work in perfect harmony and the building followed the calculated courses as if running in a groove.

The radius was next shortened to 156 ft. and the center advanced to a point opposite the middle of the building. This was the critical point in the whole undertaking. However, the building responded perfectly to the rollers and the rotunda was cleared. The radius was then lengthened to 297 ft. and the building swept around on this curve a distance of 235 ft.; thence 165 ft. on a 1345-ft. radius; thence 5 ft. on a tangent to its final position.

THE FINAL LANDING

The last 5 ft. had been reserved to correct any irregularities that might develop in case the building did not accurately follow the projected course. But the movers handled the rollers so skilfully that the building went into place without a waver. Some idea of the nicety of the handling can be gained by knowing that the building was but ⅝ in. narrower than the lot and no part of it is over the line. The building is now resting on its own foundation, the ground floor is restored and the structure is already occupied as a hotel.

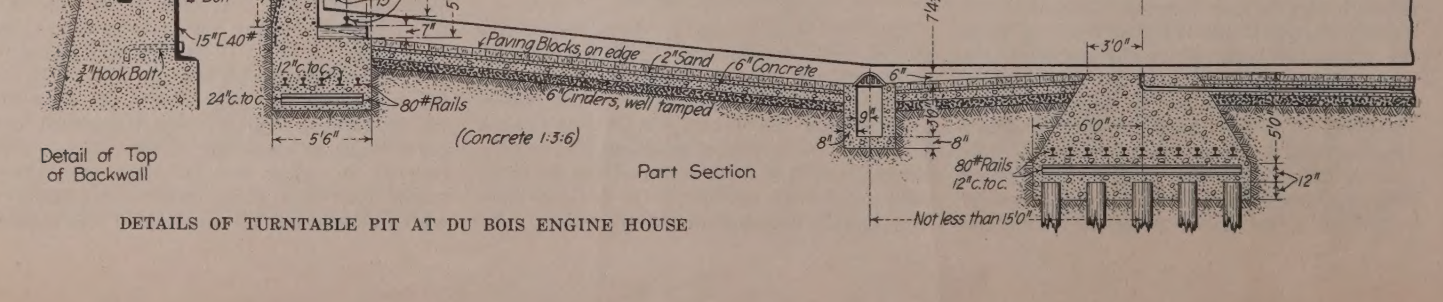
Aside from the cracking of the plaster in some of the upper rooms, due to the shock of pulling the buildings apart, the building was undamaged. Mr. Bruce will make between $30,000 and $40,000 on the venture, which he richly deserves as his reward for accomplishing what was generally considered to be an impossibility.

Du Bois Turntable Pit

Details of Design Adopted by Buffalo, Rochester & Pittsburgh Railway in Connection with New Engine House

IN conjunction with the building of the new reinforced-concrete and brick sixteen-stall engine house of the Buffalo, Rochester & Pittsburgh Railway at Du Bois, Pa., which was described in the Engineering Record of Feb. 6, page 167, the old 70-ft. turntable was replaced by one 90 ft. long of the American Bridge Company's standard design, Cooper E-60 loading. The accompanying details of the turntable pit may be of some interest as representing the latest practice of this company.

THE SANTA FE CROSSING of Diablo canyon, used as the front cover illustration of the Feb. 13 issue, was located, according to an error in the caption used, in Colorado. The structure is in Arizona.



DETAILS OF TURNTABLE PIT AT DU BOIS ENGINE HOUSE

Variations in Practice Disclosed by Water Sterilization Statistics

Francis F. Longley, Before American Waterworks Association, Discusses Status of Hypochlorite and Liquid Chlorine Methods of Treatment

BASING his figures upon 110 replies received from 240 inquiries, Francis F. Longley, of the staff of Hazen, Whipple & Fuller, consulting engineers of New York City, presented before the New York section of the American Waterworks Association at its meeting on Feb. 24 a paper showing the extent to which water sterilization is used, the cost of installation and operation, the prevalent materials for tanks and piping, and the general effects of the treatment on the typhoid death rate. The data represent water supplies of 2,000,000,000 gal. daily. An abstract of his address follows:

Eighty per cent of the replies named hypochlorite and 20 per cent liquid chlorine as the sterilizing agent. About 75 per cent of the supplies regarding which information was received are river waters, about 20 per cent are from lakes, and the small remainder are ground waters.

The first application of hypochlorite noted among the replies was in 1908, in which year disinfection by this means was begun at the Bubbly Creek plant at the Union Stock Yards in Chicago; at the Boonton reservoir of the Jersey City supply, and upon the municipal water supply of Poughkeepsie, N. Y. The several years following showed a rapid increase in the number of installations, although the records of 1913 indicate a falling off. The rates for the year 1914 are incomplete. Of the total installations regarding which replies were received, the percentages installed each year are given in the table.

About 37 per cent of the cities replying use disinfection without other treatment. The balance use it as an adjunct to some treatment—in most cases filtration. In 57 per cent of those cases in which it is used as an adjunct to filtration, it is used as a final treatment. In 26 per cent it is used after coagulation or sedimentation and before filtration. In the remaining 17 per cent it is applied before coagulation and filtration.

POINT OF APPLICATION

The data at hand do not give any reasons for the application before coagulation. In general, an effective disinfection may be secured with a smaller quantity of hypochlorite if it is applied after rather than before filtration. It should be noted that the storage of chlorinated waters in coagulating basins and its passage through filters tends to lessen tastes or odors contributed by the treatment, and this fact may in some cases account for its use in this way. Beyond this there is nothing in the moderate amount of bacterial data secured in connection with this work that enables us to generalize upon the relative advantages of these different points of application.

COSTS

The cost per million gallons for the equipment required for this treatment varies from $4 to $2,400. These variations are accounted for by the fact that designs for equipment of this sort vary widely. Some are the merest makeshifts, while others are elaborate. Some of the costs quoted include no building costs, while others include expensive structures. Taking the figures as they stand, as the data do not permit any further analysis, the total costs per million gallons are stated not to exceed $25 in 12 per cent of the supplies, $50 in 30 per cent, $100 in 42 per cent, $250 in 67 per cent and $500 in 87 per cent of the supplies about which information is available.

The total cost per million gallons for the process also varies widely. By far the greater number of costs stated lie between 10 and 50 cents per million gallons, the average for these being about 25 cents.

TANKS AND PIPING

The information at hand indicates that the commonest construction of tanks for hypochlorite is concrete. About 67 per cent of the replies stated that they had either concrete tanks or tanks of wood or iron, lined with concrete. More than 20 per cent are of wood without lining. The balance are either wood with lead lining, wood or iron with some protective or acid-resisting paint, or porcelain lining. The liquid chlorine is universally contained in special iron cylinders.

GROWTH IN THE USE OF WATER STERILIZATION WITH HYPOCHLORITE AND LIQUID CHLORINE

Year	Percentages Installed	Million Gallons Per Day Represented
1909	13	100
1910	14	450
1911	22	320
1912	22	710
1913	18	70
1914	8	265

The piping seems in general to have been put together of the materials most easily available, without regard to corrosion. Fifty-six per cent of the replies indicate the use of iron pipe, either black or galvanized, 15 per cent use lead pipe, and about an equal number use brass. A few use lead-lined iron pipe, cast-iron pipe, hard rubber, rubber hose, bronze or copper pipe.

The same comments apply to the kind of valves and fittings commonly used. Sixty-six per cent of these are of brass such as are usually found in stock; 14 per cent state that bronze valves and fixtures are used, but it is possible that some, if not most of these, upon further inquiry, might prove to be brass. A few use iron valves or fittings and a few have fixtures made of vulcanite, rubber composition, lead, copper, glass, etc.

The materials commonly used which seem to have shown the greatest resistance to the corrosive effects of hypochlorite are concrete tanks, lead pipe and rubber composition. Several of the answers indicate that copper, cast iron and lead-lined iron pipes are used without corrosion, and a number indicate, too, that brass and galvanized iron are used without corrosion. The evidence as to these two last materials, however, is contradictory, as other answers indicate considerable corrosion with galvanized iron and brass. It seems likely that the quality of the material and some peculiar local conditions may, perhaps, be determining factors in the corrosive effect upon these two materials. The results show the unmistakable corrosive effect upon wrought iron and also upon wood.

VARIATIONS IN STRENGTH

Evidence has been found in the past of occasional large variations in the strength of commercial hypochlorite. In answer to an inquiry on this point, only 29 per cent indicated that the strength of hypochlorite as purchased had been determined. That this is a point of considerable importance is indicated by the following figures:

The maximum percentage of available chlorine stated was 42 per cent. Numerous others ran as high as 40 per cent. The minimum stated was 15 per cent, with several others less than 20 per cent. The average strength was 33 per cent. In two cases the maximum percentage strength noted is as large as two and one-half times the minimum strength. These variations in quality in the commercial hypochlorite are significant, and it is obvious that the strength should be determined and a correction made in the application, if necessary, if the best results are to be secured.

AMOUNT OF DOSE

The maximum dose of hypochlorite stated is 60 lb. per million gallons, which is at the Bubbly Creek plant in Chicago, where the nature of the water treated is well known to require a large dose. The lowest maximum quantity stated is 4 lb. per million gallons. The average of all the maximums stated for the various plants is 17 lb. per million gallons.

Bubbly Creek also shows the highest average dose of 55 lb. The next highest is 35 lb., and the lowest average dose stated is 3 lb. The average of all the averages stated is about 11 lb. per million gallons.

Judging from the lack of information in response to inquiries bearing upon the relation between the quantity of hypochlorite required and the color or turbidity in the water, it seems that a surprisingly small amount of attention is given in the various cities to following out this relationship. A knowledge of this relation is of some importance, as it influences the quantity of hypochlorite that is required for a given water, the quantity that may be applied without producing objectionable tastes and the economy of the treatment.

The reason for the lack of attention to this point seems to lie in the fact that the cost of the hypochlorite required for any water is trifling and it is not of great importance just what quantity is applied, so long as it is enough, on the one hand, to give good bacteriological results, and, on the other hand, not so much as to produce objectionable tastes and odors.

The doses that fulfil these two conditions do not always coincide. The character of some waters is such that the dose which can be applied without contributing objectionable tastes and odors is more than enough to produce the desired bacterial reduction. With such waters there is no difficulty in regulating the dose to give satisfactory results from every point of view. The character of other waters is such that the maximum dose which can be used without giving a taste is not enough to give the bacterial reduction required. This is the difficult condition to meet. It is found more frequently in raw waters than in filtered waters.

Tastes and Odors

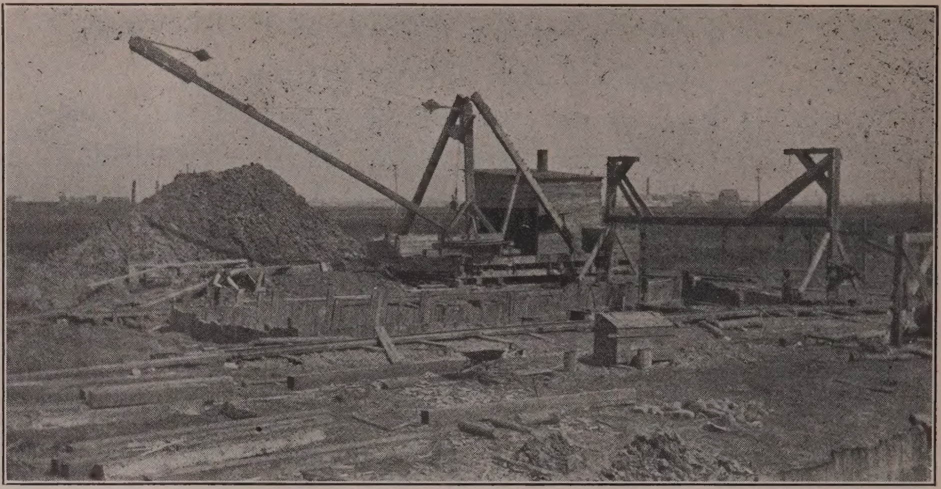
It is everywhere recognized that there are certain times when the hypochlorite treatment is less satisfactory than at others. This is shown principally in the appearance of tastes and odors that occasion complaint among consumers, or in a low and unsatisfactory removal of bacteria by the treatment. It occurs generally at a time when the turbidity or the color of the water increases greatly, or some other marked change, such as temperature, occurs in the condition of the untreated water.

Different waters vary a good deal in this respect, and but little information can be found which gives light upon the specific reasons for this variation and permits the formulation of general statements in regard to it.

An analysis of the figures at hand shows that in one place a maximum dose as great as 37 lb. per million gallons has not given rise to objectionable tastes or odors, and in numerous places 20 to 30 lb. has not been noticeable. The average amount stated for which no odor or taste was noticed was about 14 lb. per million gallons. The supplies in which it was definitely stated that no tastes or odors were noticeable included about 40 per cent of the total. Among the others there were general comments as to the occurrence of objectionable tastes or odors, indicating in the main that they are likely to occur with changes in the character of the water treated, especially at times of storm or freshet.

Relation Not Established Between Color and Amount of Dose

So far as is indicated by the somewhat incomplete data, the largest quantities of hypochlorite are used in those supplies in which the color or turbidity of the water is highest. Unfortunately, the information is not complete enough to enable any relationship to be established even in an approximate way between color, turbidity and quantity of disinfecting agents that may be used without objection.



SIDE WALL TRENCH WORK BEING HANDLED WITH LIGHT TRAVELER DERRICK

Constructing Pumping Station in Unbraced Cofferdam Formed by Outside Walls

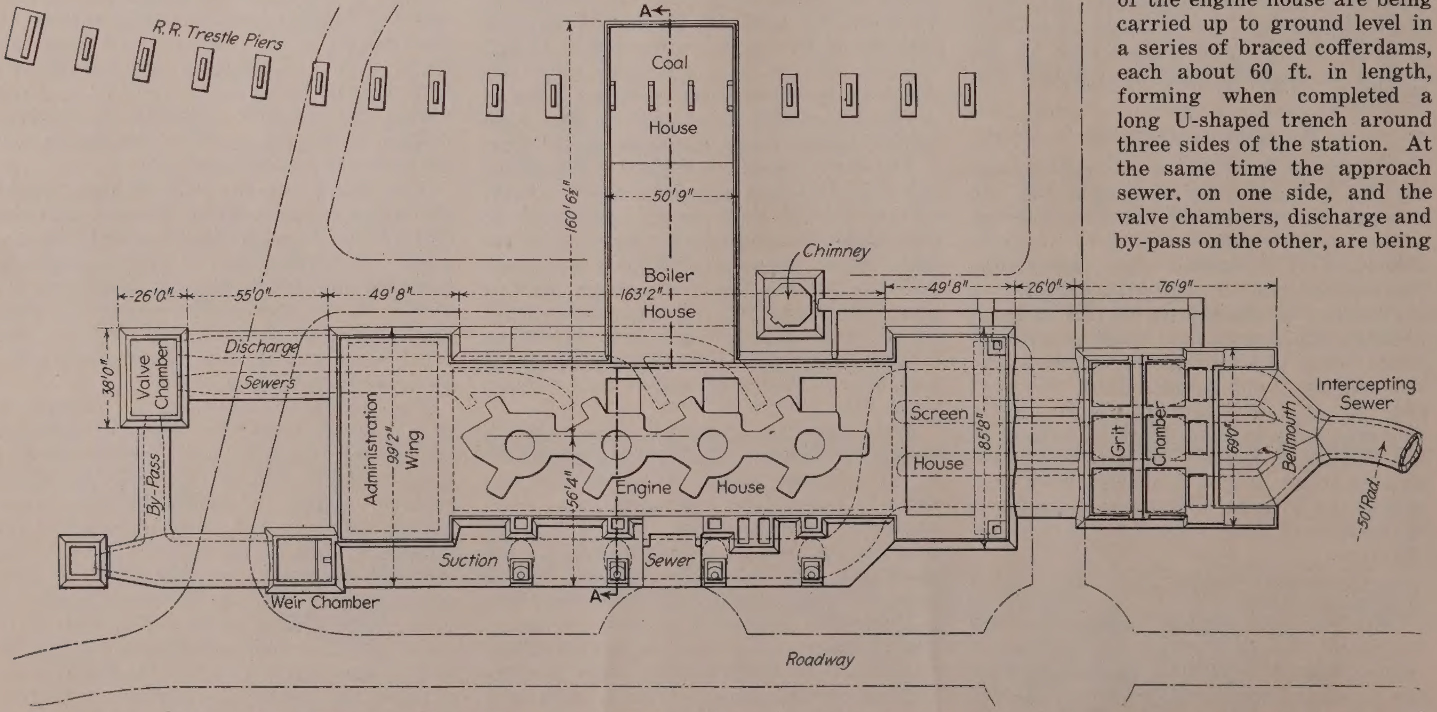
Soft Ground Forces Contractor on Passaic Valley Sewer to Put Main Construction Plant on Future Power House Foundation

By constructing the outside walls first, to stand as an unbraced cofferdam for the main work, the contract for section 5, the pumping station, of the Passaic Valley sewer is being carried on rapidly and economically. This pumping station, located on the Jersey Meadows near Doremus Avenue, Newark, will raise water from the main sewer to the elevated settling basins, whence it will be discharged through the pressure tunnel under Newark Bay to Bayonne. The contract for the settling basins has not yet been let. The work here described comprises the pumping plant, with about 1000 ft. of approach sewer, the power house, and the permanent concrete viaduct for the coal siding.

Design and Construction Plan

The accompanying plan and section illustrate the structural features of the design. The sewage enters the bellmouth, divides into three streams, passes the grit chamber and screen house, recombines, turns to the left, and is drawn through the suction sewer into the pumps. From them it is forced under pressure into the discharge sewer, and conducted through a valve chamber to the elevated settling basins. A by-pass enables untreated sewage to be run directly into the siphon under the original head in case of emergency. The plan shows that an excavation some 40 ft. deep and 103 x 380 ft. in plan is involved, in which complicated form work for 20,000 cu. yd. of heavily reinforced concrete must be built. To excavate this in cofferdam, and build the forms with the bracing in the way, would have been an expensive and difficult procedure.

To obviate this trouble the back wall of the administration wing and the side walls of the engine house are being carried up to ground level in a series of braced cofferdams, each about 60 ft. in length, forming when completed a long U-shaped trench around three sides of the station. At the same time the approach sewer, on one side, and the valve chambers, discharge and by-pass on the other, are being

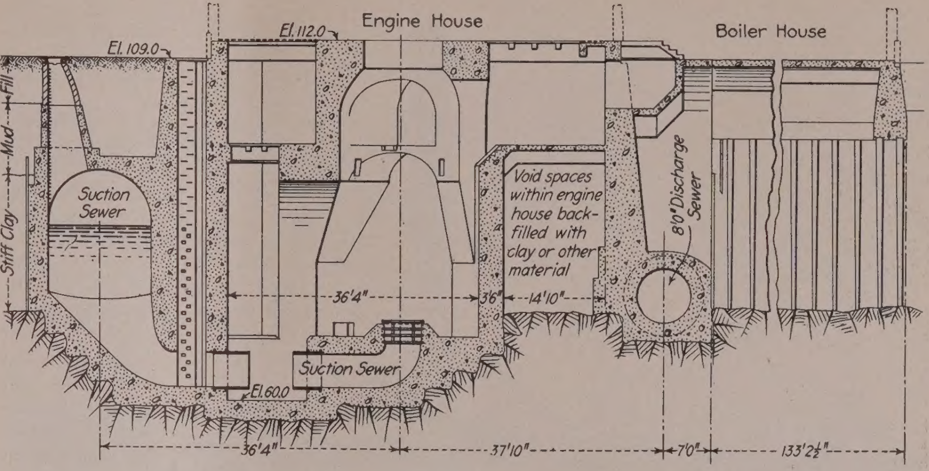


PUMPING STATION WHICH RAISES SEWAGE TO SETTLING BASINS ELEVATED TO GIVE HEAD ON NEWARK BAY SIPHON built in open trench. The screen house will next be constructed, and two derricks set on it will excavate the space between it and the grit chamber. As soon as the concrete is placed, the derricks will move forward and construct successively the grit chamber and the bellmouth. These three excavations, being much smaller in area than the main power house, though too large for convenient braced trench work, will be open, unbraced pits with sloping sides.

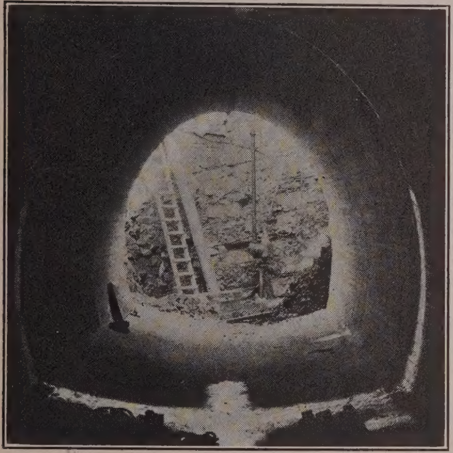
While this work is going on the travelers which have done the work in the trenches will excavate with orange-peel buckets the center of the power house, backfilling the U-shaped trench outside the concrete, and distributing the excess excavated material to the large area surrounding the power house. There are two of these travelers following one another on each side of the trench, one doing the preliminary excavation and the other finishing the excavation, pulling timbers, handling forms, etc.

SUPERSTRUCTURE AND CONCRETE TRESTLE

While the main body of the pumping station is being completed, the concrete coal trestle will be built. That part of the pumping station above ground will then be finished. Last of all, part of the power house will be concreted, one mixer moved to it, and the main concrete plant torn out so that the balance of the power house may be finished.



SECTION OF PUMPING STATION AT A-A OF PLAN ON OPPOSITE PAGE



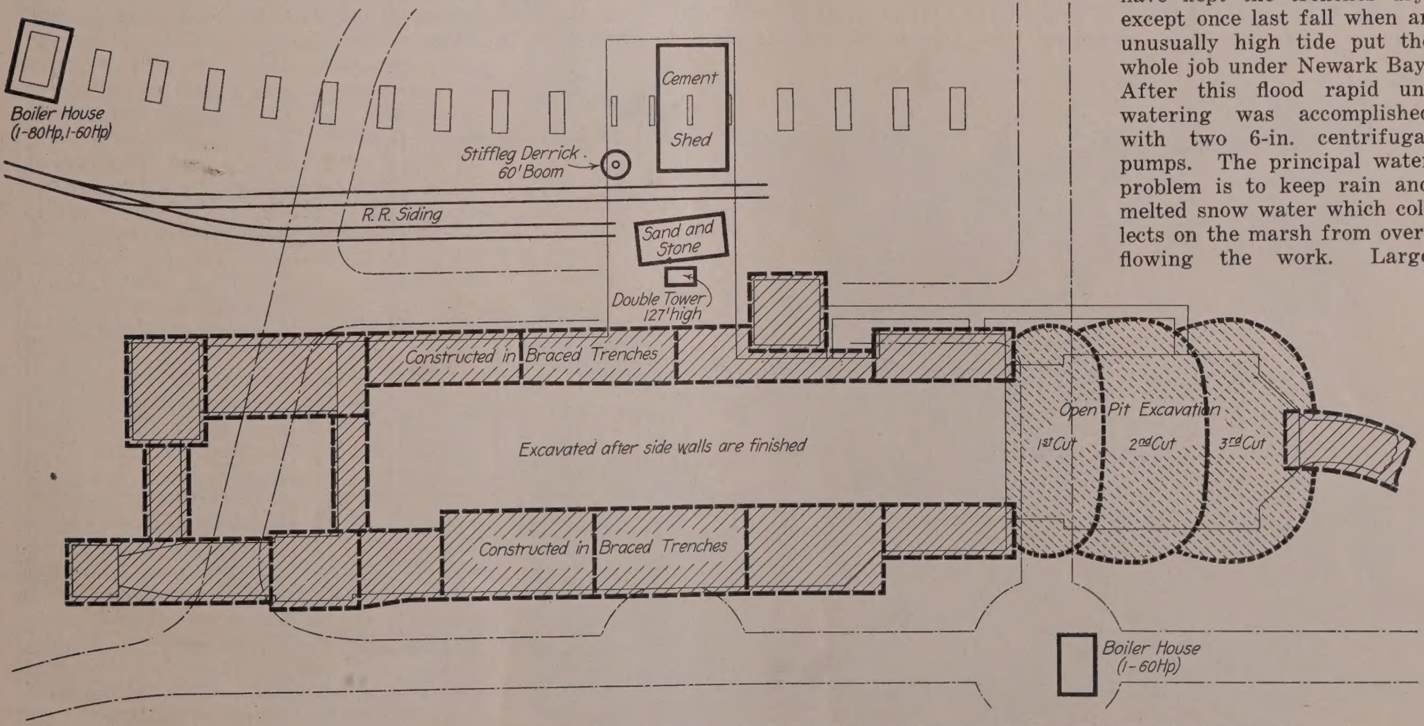
APPROACH SEWER SECTION

PLANT LAYOUT

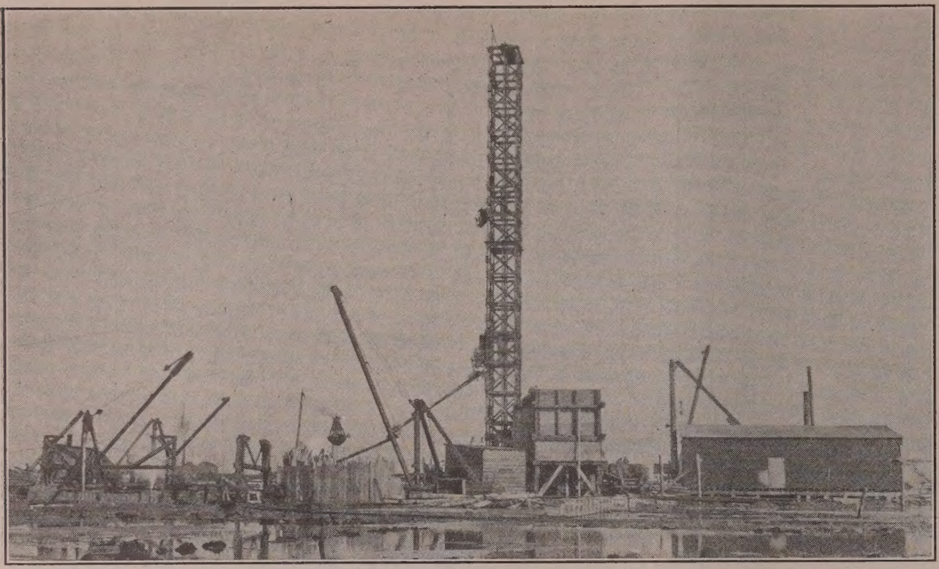
The swamp at the site was so soft that pile foundations were necessary for the temporary plant. Difficulty was even experienced in handling light travelers on this mud, until hard clay taken from the lower 20 ft. of trench excavation was available to make a fill foundation for them. The first work of the job was to drive with an ordinary land machine the piles for the power house and coal track foundations and anchor piles for the tower guys. The concrete plant, a sketch of which is shown herewith, was then set up on these piles. The bins were arranged on a skew to bring them both within the radius of a 60-ft. boom. Both mixers dump directly into one chute, which leads to either skip of the double tower. Duplication of plant from mixer to form gives flexibility, insurance against breakdown and double capacity when wanted. The hoppers have to be changed seldom, that for one skip being at present raised 70 ft. to reach the far corner of the power-house foundation, and that for the other being lower for work close to the tower. The extreme height of the tower, 127 ft., will be needed for concreting the coal trestle, the bellmouth and the valve chambers. About 200 hp in boilers is used to run the plant, including a small generator set, beside the hoist boilers on the traveler derricks.

SOIL CONDITIONS

About 10 to 16 ft. of marsh mud and soft blue clay overlies the entire site. For a good part of the length of the approach sewer, weathered sandstone rock is found a few feet below the surface. At the site of the power house the last 20 to 25 ft. of excavation consists of a hard red clay, which has to be picked or loosened with light shots before an orange-peel will dig it. As shooting in the braced trenches caused the side banks to slip and endangered the bracing, it was abandoned and most of the excavation of this material so far has been done by hand. Hard-pan is encountered in the bottom of the excavation. There is little trouble from water in the excavation. Two 4-in. pumps and one or two smaller feeders have kept the trenches dry, except once last fall when an unusually high tide put the whole job under Newark Bay. After this flood rapid unwatering was accomplished with two 6-in. centrifugal pumps. The principal water problem is to keep rain and melted snow water which collects on the marsh from overflowing the work. Large


Boiler House (1-80Hp, 1-60Hp)
Cement Shed
Stiffleg Derrick 60' Boom
R.R. Siding
Sand and Stone
Double Tower 127' high
Constructed in Braced Trenches
Excavated after side walls are finished
Open Pit Excavation
1st Cut
2nd Cut
3rd Cut
Constructed in Braced Trenches
Boiler House (1-60Hp)

LAYOUT OF CONSTRUCTION WORK—SPACE IN CENTER EXCAVATED WITHOUT BRACING AFTER COMPLETING SIDE WALLS



CONSTRUCTING SIDE WALLS—CONCRETE PLANT ON POWER HOUSE FOUNDATION

Notice surface water from recent melting of snow standing on marsh

sheets of this water standing behind the small dikes built around the work may be seen in the accompanying illustration.

DISPOSAL AND FILL

It is proposed to use the excavated material to make a solid fill around the completed plant. To get rid of the marsh mud taken out, it is planned to mix it with clay for the top layer of fill. Therefore, the mud, which comes out first, has to be piled as high as possible in two or three narrow dumps near the trenches, and rehandled after the clay has been taken out and distributed. It is proposed to make roadways on the top of this fill of broken stone, taken from the approach sewer trench. The spoil is handled in 1-yd. V-body dump-cars drawn by mules or pushed by hand. For piling up the marsh mud temporary trestles were built on light piles, as it is impossible to handle track on top of such soft fill.

PROGRESS

In attacking a problem where rapid progress is desired, the thing of prime importance after finishing necessary preliminary work is to develop as much of the work as can be done at one time. The preliminary work on this contract, because of the soft ground, was vexatious and slow; but while it was being done the approach sewer was gotten well under way. Part of this was concreted with a ½-yd. portable mixer. While the main mixer plant was being set on the pile foundation of the power house the side trenches were started. These were opened up in 60-ft. sections, beginning at the lower end, and concreted to ground level as fast as excavated. Wood sheeting 3 in. thick was driven down as the excavation progressed, for the first few feet by hand, and then with light steam-hammers hung from a traveling frame. The job began last June, and at present the braced trench excavation is practically completed, and the concrete on each side about two-thirds done. As soon as the upper ends of the side walls are concreted, a derrick can be set on each wall to proceed with the work on the screen house and approach tubes, while two travelers attack the central excavation and a fifth completes work on the outlets. In order to avoid delay in form building, the curved surfaces and other forms requiring difficult carpenter work are being built in advance as rapidly as possible, and will be ready to set in place when the excavation is finished.

The work will be completed about next August. It is being done by P. J. Moranti, Inc. Mr. Moranti himself spends considerable time on the work, and B. W. Fordham is the engineer in charge.

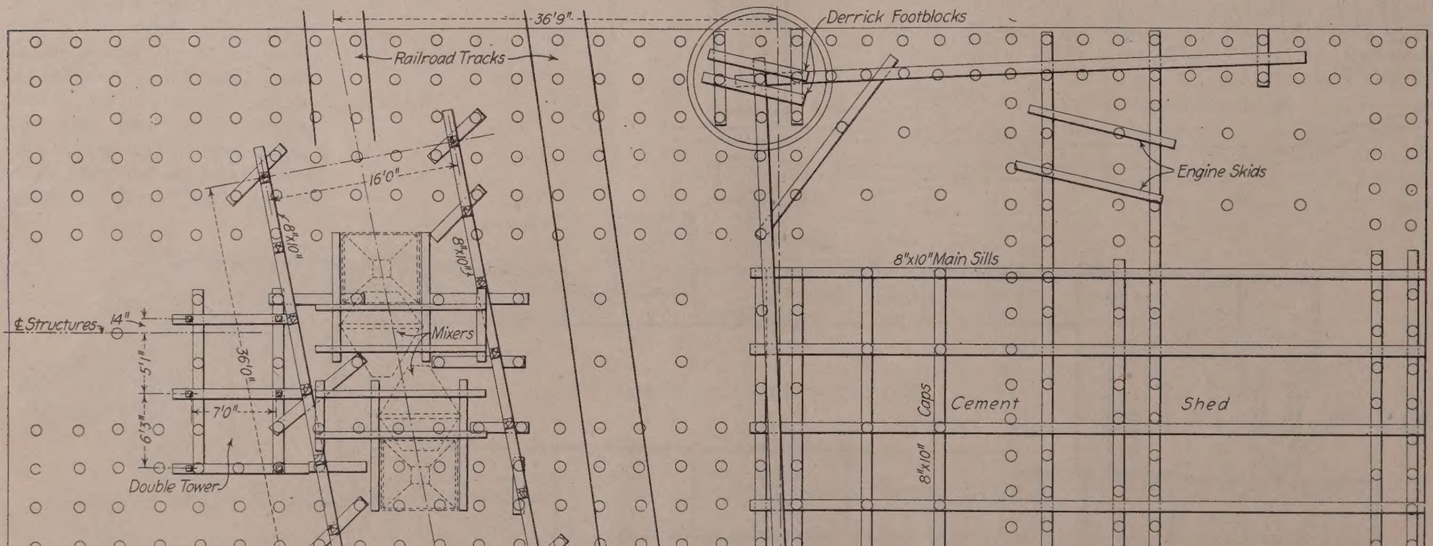
Declares Linseed Oil Cures Dusty Concrete Floors

ELIMINATION of dusting in concrete floors after they have shown that undesirable quality was attempted by thirty different methods and only two or three were found satisfactory, said Cloyd M. Chapman in a discussion at the American Concrete Institute. Silicate of soda he found was better than most of the proprietary remedies. Twelve years ago when the dust on the floor of an electric power plant did damage to the bearings of the machinery he applied linseed oil with satisfactory results. Raw oil was used and the excess wiped off with waste. Lampblack was added to give the floors a uniform slate color, the oil alone producing a mottled appearance on account of the unequal absorption.

R. G. Perrot stated that he had had an unfortunate experience of peeling in mixing carborundum with a patented mixture. Concrete made of blast-furnace slag had given him excellent service in the corridors of a school building.

Leonard C. Wason asserted that boiled oil was better than raw oil, as one could get upon it quicker. Silicate of soda had also proved effective. He had the floors mopped to remove the surplus between the second and third coats, if so many coats were necessary in order to bring about the desired results.

To prevent dusting in the first place it was agreed that small-sized sand should not be used and that an excess of moisture should be avoided. The application of moisture by sprinkling for ten days is essential but hard to bring about in buildings.



DUPLICATION OF UNITS IN CONCRETE PLANT INSURES AGAINST DELAY AND GIVES DOUBLE OUTPUT WHEN WANTED

Materials for Concrete Road Delivered by Industrial Cars from Central Plant

On Oregon State Highway Work Specially Designed Mixer Picks Up Loaded Hopper Bodies from Gasoline Drawn Train

IN order to cut costs to the minimum, save time and yet get good workmanship, a number of new methods of handling materials for concrete road work have been put in use by the Oregon State Highway Department, on State road work between Astoria and Warrenton, a distance of 3 mi. The pavement consists of a concrete slab 6 in. thick, laid on an existing macadam road, and extends approximately 1½ mi. in both directions from the county bridge across the Lewis and Clark River. The slab is 8 ft. wide and is flanked on each side by a 4-ft. macadam shoulder, giving a 16-ft. roadway.

ARRANGEMENT OF CONCRETE PLANT AND SUPPLY TRACKS

CENTRAL MATERIAL YARD

Material bunkers, having a capacity of about 225 cu. yd. of rock, were located on the Lewis and Clark bridge, and had been used for country road work. Following the plan to distribute all materials from a central material yard, a cement storage shed, having a capacity of 500 bbl., was attached to one side of the bunkers, over the roadway. A hopper was built over the bunkers to distribute the raw materials, and a derrick with clamshell bucket was so placed that material could be taken from scows on either side of the bridge. The aggregates, consisting of ¾-in. basalt screenings including the dust, and 1½-in. crushed basalt rock, were delivered at the bridge in scow-load lots of about 500 cu. yd. each, and the cement in lots of 500 bbl. per scow.

The equipment for transporting the raw materials from the central material yard to the concrete mixer consisted of 2 mi. of 24-in. gage 16-lb. portable track, together with two complete turnouts with spring switches, the rails being in 15-ft. lengths fastened with seven steel cross-ties; twelve Koppel special steel hopper cars, each car carrying three removable hoppers of 12-cu. ft. capacity each; and a 4½-ton 20-hp Milwaukee gasoline locomotive. The concrete paving mixer, specially designed to handle the materials from the cars direct, had a structural steel frame body on wheels, on which was mounted a 1/3-yd. Austin cube concrete mixer. A boom with an automatic traveler attachment to which was fastened a bail for picking up the hoppers from the industrial cars could be swung horizontally in either direction from the charging hopper. Power to drive the mixer, raise the loaded hopper, swing the boom, and propel the paver itself, was derived from a 14-hp Heer gasoline engine.

In loading, the cars were run under the bunkers, and the cement, lime, screenings and rock measured, so that each of the three hoppers on every car contained a full charge for the mixer. The material cars were made up into three trains of four cars each, so that one train could be loading, one discharging, and one in transit. The train was then taken out to the site of the work and left standing alongside the mixer. Each hopper in turn was picked up by the boom, raised and swung around, and the contents dumped into the receiving hopper over the mixer drum. The mass was mixed for 1 min., by the watch, when it was discharged into the receiving bucket, and distributed on the road. After 20 lin. ft. of pavement were placed the mixer was moved ahead a corresponding distance, and the operations repeated. In operating the mixer six men were used—an engineer, two men operating the elevating device, two men at the charging hopper, and the sixth man at the bucket.

PREPARING THE OLD PAVEMENT

Before the pavement was laid the surface of the old macadam road was scarified, hand-picked and rolled, and an effort made to make the grade as uniform as possible without disturbing too much the existing macadam, since the entire 3 mi. of this road was built up through a reclaimed swamp. Two small wooden bridges were removed and fills made in their place, 36-in. concrete pipe culverts being placed for drainage. The 2 mi. of track were laid along the side of the existing road, except on that portion south of Young's River bridge, which was built on top of a narrow dike 10 to 14 ft. wide. Here it was necessary to lay the track on the roadway, and to build turnouts on trestles at the side to carry the cars past the paver. These turnouts were long enough to take care of at least a day's run by the mixer.

River water, either from the Lewis and Clark or from Young's River, was the only supply available for the concrete. The pumping plant, consisting of a 4-hp Fairbanks-Morse vertical oil engine, and a 3½ x 6-in. Duplex power pump, belt connected, was first located at the Young's River bridge. The water, at 100 lb. pressure, was carried for 6000 ft. in a 2-in. galvanized iron pipe line, with hose connections at intervals of 200 ft. The pumping plant was moved as the work progressed, three additional settings being necessary.

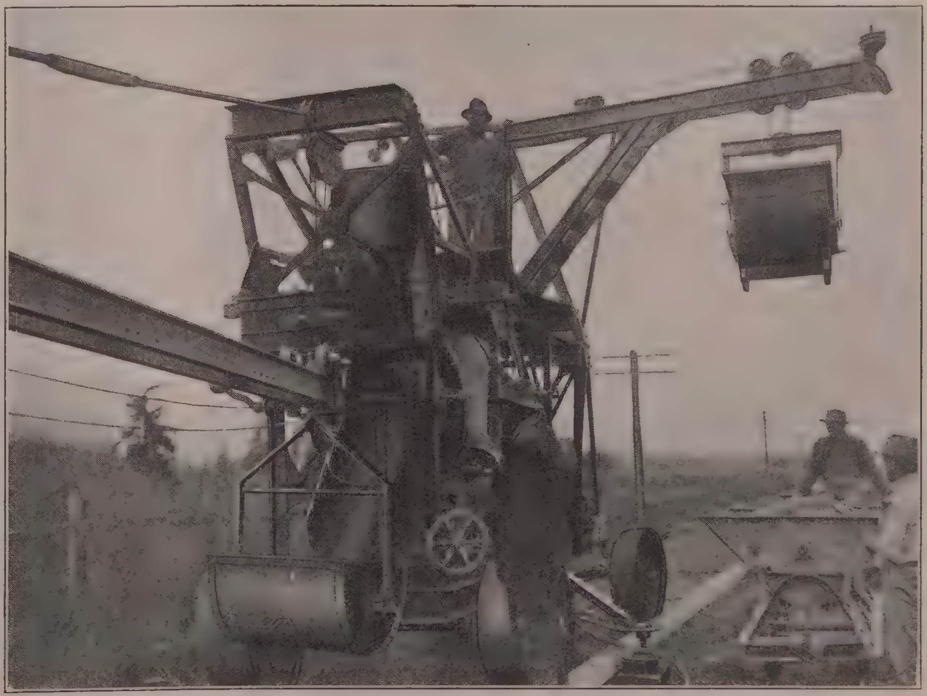
The first 2020 lin. ft. of pavement were laid with single course, and the remainder of the work with two-course pavement. Wooden forms, made from 5¼ x 5¼-in. lumber were used to confine the concrete. These forms were aligned, spaced the proper distance apart, and held in position by drift bolts, which were driven through them and into the macadam beneath. The road was then well moistened, and after deposition and striking off the concrete was floated to a semi-smooth finish.

IRONING OUT THE CONCRETE

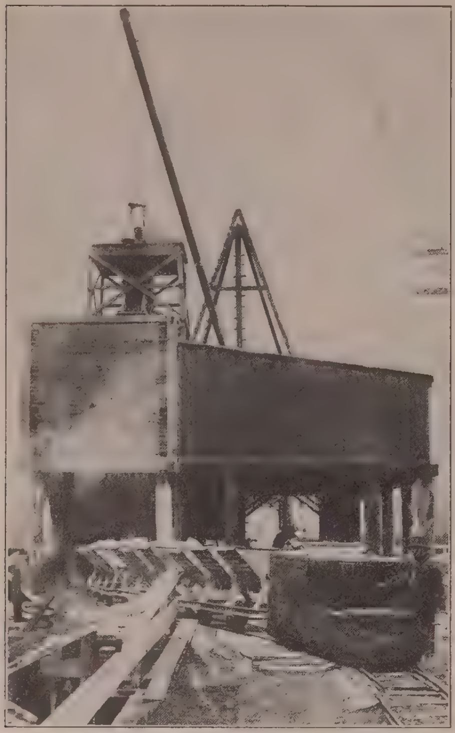
In order to obtain the greatest density in the concrete a special concrete roller, driven by a gasoline engine, was operated back and forth over the concrete, using the wooden forms as tracks. This process of "ironing out the concrete" eliminated all voids or pockets in the mixture, and left it ready for finishing, which was done with a large wooden float or trowel A description of this roller was published on page 512 of the Engineering Record for November 7.

Climatic conditions were ideal for the work, the temperatures hardly being ever extreme, and at times when the evaporation was greatest, the pavement was protected by a canvas tarpaulin. The finished pavement was kept well sprinkled for a week.

Expansion joints consisting of heavy asphalted felt were inserted transversely in the pavement every 30 ft., two strips being placed ½ in. beneath the finished surface, forming a so-called concealed joint, and at every third joint a strip of heavier mate-



MIXER WITH BOOM WHICH PICKS UP CAR BODIES FROM INDUSTRIAL TRACK



GASOLINE-DRIVEN TRAIN OF MATERIAL CARS

rial was inserted through the entire slab. In placing the last 1400 ft. of pavement, all joints were omitted. Careful inspections of the finished pavement have failed to show any cracks at other places than those provided for by the joints.

USE HYDRATED LIME

The cement for this work was delivered in large quantities, direct from the mill, and stored in Astoria, being removed to the central material yard on scows as required. Each shipment of cement was sampled and tagged, and seven and twenty-eight-day tests made before it was used. Hydrated lime was added to the cement to the extent of 10 per cent to increase the plasticity of the mixture, and to hold the moisture until the cement had fully crystallized. The hydrated lime was delivered in carload lots, each shipment being carefully tested. As the work progressed, samples of the concrete mixture were taken, cast in cylindrical metal molds, and compression tests made. As the result of tests made with the materials available, the following proportions were used throughout the work: For single course pavement, 1 part cement, 1¾ parts screenings and 2¼ parts rock; for two course pavement, the 4-in. base was composed of 1 part cement, 2¼ parts screenings and 3 parts rock; and the 2-in. top was a rich mixture of 1 part cement to 3 parts screenings.

The pavement laid totaled 16,560 lin. ft., 14,720 sq. yd., and 2300 cu. yd. of concrete in place. The table in the preceding column gives the costs per square yard for each item.

COST PER SQUARE YARD

Cement	$0.629
Lime	.094
Rock and screenings	.336
Reinforcing	.004
Expansion joints	.014
Placing tracks	.126
Loading cars	.049
Locomotive	.037
Mixer	.100
Water supply	.039
Forms	.054
Spreading	.035
Finishing	.015
Concrete roller	.006
Sprinkling and covering	.004
Overhead	.218
Total	$1.760

The construction of the road was carried out under the direct supervision of H. L. Burras, construction engineer, reporting to H. L. Bowlby, State highway engineer of Oregon.

Facilitating Timber Design

Tables and Diagrams Used in Connection with the Structural Work on the New York State Building, Panama-Pacific Exposition

By SIDNEY DIAMANT
Consulting Engineer, New York City

TO facilitate the design of the timber frame of the New York State Building at the Panama-Pacific Exposition the writer established tables and curves based on the permissible unit stresses, the loadings and the different lengths of span. The lumber used is Oregon pine and Table 1 gives the assumed permissible unit stresses.

TABLE 1—UNIT STRESSES FOR OREGON PINE IN POUNDS PER SQUARE INCH

Tension	1,200
Compression:	
End bearing	1,600
Across grain	350
Transverse compression and tension on extreme fibres	1,500
Shear with grain	150
Modulus of elasticity:	
Live load	1,500,000
Dead load	1,000,000
Columns	
For length under 15 times least side	1,200

For length over 15 times least side, use the formula,

$$P = 1600\ (1 - L/60D)$$

where p = unit pressure in pounds per square inch; L, length in inches or feet, and D, least side in inches or feet correspondingly.

Maximum permissible value of $L/D = 60$.

The building is given a plaster coat imitating Travertine stone, and to prevent cracking it was considered necessary to limit the deflections of the wooden members. As the framework is finished before the plaster is applied it was necessary to figure deformations due to live loads only. The maximum permissible deflection that would not crack the plaster was assumed to be 1/360 of the span. Table 2 gives the assumed dead and live loads per square foot of the various floors.

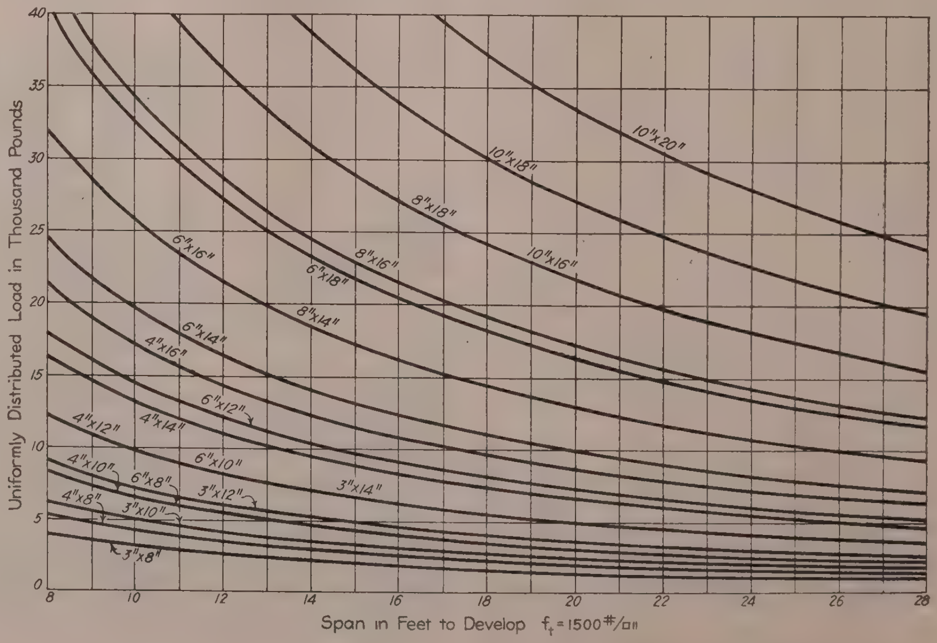
As a considerable number of beams of various spans and unit loads had to be calculated, it was found advantageous to develop diagrams and tables, from which could be selected the proper sizes of beams for the various conditions of loading. The modulus of elasticity for live load was assumed as 1,500,000 and for dead load 1,000,000 lb. per square inch. As the total load had to be considered in the bending moments, but only the live load in the deflections, a modulus of elasticity of 1,300,000 was assumed as applicable for all cases. As the relative total load to live load was a variable, not less than five cases had to be considered—total load 156 lb. per square foot, including a live load of 90 lb.; total load 150 lb. and live load 120; total load 141, live load 75; total load 105, live load 75; and total load 50, including a live load of 30 lb. per square foot.

TABLE 2—LOADING IN POUNDS PER SQUARE FOOT

Location	Dead load	Live load
First floor, wood surface	30	75
First floor, other than wood surface	66	90
General floors, wood surface	30	75
Toilets, tile floor	66	75
Trunk room	30	90
Ballroom floor, impact included	30	120
Ballroom ceiling	30	0
Roof	20	30

DIAGRAMS

Two diagrams were used, one for bending moments under a total load developing a maximum fiber stress of 1500 lb. per square inch, the other for deflections not exceeding 1/360 of the spans under live loads, assuming a spacing of 16 in. on centers of beams. The sizes of plans and timbers used ran from 3 x 8 in. to 10 x 20 in. The diagrams are given herewith and their use is self-explanatory, as it is evident that the condition requiring the largest cross-section governs.



UNIFORM LOADS DEVELOPING MAXIMUM BENDING STRESSES OF 1500 POUNDS

TABLE 3—SAFE SPAN, CONSIDERING BOTH STRENGTH AND DEFLECTION, IN OREGON PINE BEAMS—SPACED 16 INCHES ON CENTERS

Size of beam	Section modulus	Moment of inertia	Total load 105 S	Live load 75 S_1	Total load 150 S	Live load 120 S_1	Total load 156 S	Live load 90 S_1	Total load 141 S	Live load 75 S_1	Total load 50 S	Live load 30 S_1
2x 6	12.0	36.0	9 ft. 3 in.	8 ft. 10 in.	7 ft. 9 in.	7 ft. 7 in.	7 ft. 7 in.	8 ft. 4 in.	8 ft. 0 in.	8 ft. 10 in.	13 ft. 5 in.	12 ft. 0 in.
2x 8	21.3	85.3	12 ft. 4 in.	11 ft. 10 in.	10 ft. 4 in.	10 ft. 3 in.	10 ft. 1 in.	11 ft. 1 in.	10 ft. 7 in.	11 ft. 10 in.	17 ft. 10 in.	16 ft. 0 in.
2x10	33.3	166.7	15 ft. 3 in.	14 ft. 9 in.	12 ft. 11 in.	12 ft. 7 in.	12 ft. 7 in	13 ft. 11 in.	13 ft. 3 in.	14 ft. 9 in.	22 ft. 2 in.	20 ft. 0 in.
2x12	48.0	288.0	18 ft. 6 in.	17 ft. 8 in.	15 ft. 6 in.	15 ft. 2 in.	15 ft. 2 in.	16 ft. 8 in.	16 ft. 0 in.	17 ft. 8 in.	26 ft. 10 in.	24 ft. 0 in.
2x14	65.3	457.3	21 ft. 7 in.	20 ft. 7 in.	18 ft. 1 in.	17 ft. 8 in.	17 ft. 9 in.	19 ft. 5 in.	18 ft. 7 in.	20 ft. 7 in.	31 ft. 4 in.	28 ft. 0 in.
3x 6	18.0	54.0	11 ft. 4 in.	10 ft. 2 in.	9 ft. 6 in.	8 ft. 8 in.	9 ft. 4 in.	9 ft. 6 in.	9 ft. 9 in.	10 ft. 2 in.	16 ft. 5 in.	13 ft. 8 in.
3x 8	32.0	128.0	15 ft. 1 in.	13 ft. 6 in.	12 ft. 8 in.	11 ft. 6 in.	12 ft. 4 in.	12 ft. 9 in.	13 ft. 0 in.	13 ft. 6 in.	21 ft. 11 in.	18 ft. 4 in.
3x10	50.0	250.0	18 ft. 11 in.	17 ft. 1 in.	15 ft. 10 in.	14 ft. 7 in.	15 ft. 6 in.	16 ft. 1 in.	16 ft. 3 in.	17 ft. 1 in.	27 ft. 5 in.	22 ft. 11 in.
3x12	72.0	432.0	22 ft. 8 in.	20 ft. 3 in.	19 ft. 0 in.	17 ft. 4 in.	18 ft. 7 in.	19 ft. 1 in.	19 ft. 6 in.	20 ft. 3 in.	32 ft. 11 in.	27 ft. 6 in.
3x14	98.0	686.0	26 ft. 5 in.	23 ft. 8 in.	22 ft. 1 in.	20 ft. 2 in.	21 ft. 8 in.	22 ft. 3 in.	22 ft. 10 in.	23 ft. 8 in.	38 ft. 4 in.	32 ft. 1 in.
4x 8	42.7	170.7	17 ft. 5 in.	14 ft. 11 in.	14 ft. 7 in.	12 ft. 8 in.	14 ft. 4 in.	14 ft. 0 in.	15 ft. 1 in.	14 ft. 11 in.	25 ft. 4 in.	20 ft. 2 in.
4x10	66.7	333.3	21 ft. 10 in.	18 ft. 7 in.	18 ft. 3 in.	15 ft. 10 in.	17 ft. 11 in.	17 ft. 6 in.	18 ft. 10 in.	18 ft. 7 in.	31 ft. 7 in.	25 ft. 2 in.
4x12	96.0	576.0	26 ft. 2 in.	22 ft. 4 in.	21 ft. 11 in.	19 ft. 1 in.	21 ft. 5 in.	21 ft. 0 in.	22 ft. 7 in.	22 ft. 4 in.	37 ft. 11 in.	30 ft. 4 in.
4x14	130.7	914.7	30 ft. 7 in.	26 ft. 0 in.	25 ft. 7 in.	22 ft. 3 in.	25 ft. 0 in.	24 ft. 6 in.	26 ft. 4 in.	26 ft. 0 in.	44 ft. 4 in.	35 ft. 5 in.

A table was developed giving the relation between each size of beam used and its permissible span for each assumed case of loading. Table 3 shows the lengths of these spans. The term S is the length of span capable of sustaining the moment due to combined live and dead loads while developing an extreme fiber stress in the section of 1500 lb. per square inch. The term S_1 indicates the length of span capable of sustaining the live load with a deflection of 1/360 of its span.

The coupling of the total and live loads by columns corresponds to their occurrence in the structure. For any of the combination loadings the minimum span for the two cases governs the length of the member to resist the bending stress and provide against undue deflection.

APPLICATION

For a total load of 105 lb. per square foot made up in part of the corresponding live load of 75 lb., it is desired to select a beam for a 17-ft. span. The first and natural selection would be for strength, namely a 4 x 8-in. plank, but this would unduly deflect on a span exceeding 14 ft. 11 in. A 4 x 10-in. plank fulfils the requirements, but a 3 x 10-in. piece is more economical and also fulfils the requirements. The deeper beam is to be selected unless the architectural treatment prevents its use.

Nails and lag screws were used for connecting the beams and girders, and the lateral resistance of nails, expressed in pounds, was assumed to be 8*d*, where *d* indicates the pennyweight denomination.

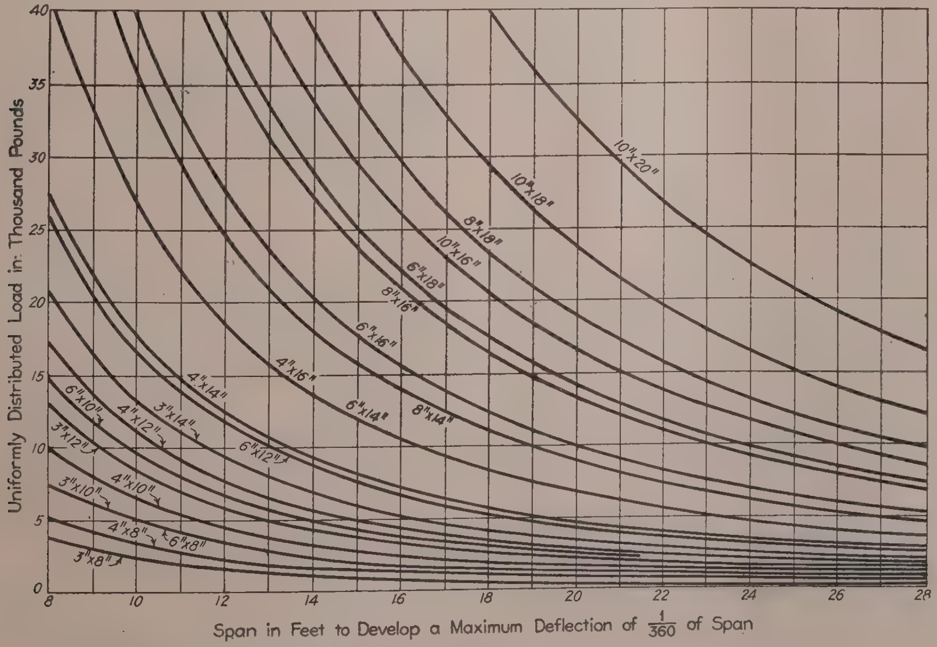
The lateral resistance of lag screws, used for connecting steel plates to wood and for wood ties 2 in. and less in width, was assumed, as in Table 4.

TABLE 4—LATERAL RESISTANCE OF LAG SCREWS

Size of screw		
Diameter, in.	Length in.	Lateral resistance, lb.
⅜	3½	700
½	4	1,100
⅝	4	1,650
¾	4½	2,100
⅞	5	2,800

FLITCH PLATE GIRDERS

In places, where the spans and loads were too long to permit the use of ordinary timbers, flitch plate girders were specified. These girders are made by bolting together steel plates and wooden beams. The theory concerning such girders embodies the selection of steel and timbers so that their widths are in proportion to their respective moduli of elasticity. Or, in other words, so that, under load, the deflection of wood and metal will be uniform. It has been found good practice to make the thickness of the metal one-twelfth the total thickness of the girder. Another advantage of this type of girder is that the wood protects the steel from exposure to fire, thus preventing its buckling and bending until the wood covering is destroyed. Accordingly the covered metal parts of such girders are more fire resisting than an exposed steel girder.



LOADS CAUSING DEFLECTIONS NOT TO EXCEED 1/360 OF SPAN UNDER LIVE LOAD

The formula used for calculating such girders was that published in the 1902 edition of the Yellow Pine Manufacturers' Handbook, which reads

$$W = (8BD/6L)K$$

where W = safe uniformly distributed load in pounds; B, total breadth of girder in inches; D, depth of girder in inches; L, span in inches, and K, a constant depending on the material and the permissible unit stresses.

In the handbook K is given as 2983 1/3 for permissible unit stresses of 1800 lb. per square inch in the lumber and 16,000 lb. per square inch in the steel. As the permissible unit stress in the timber in this case was 1500 lb. per square inch instead of 1800 this constant was changed to $(1500/1800) \times 2983\ 1/3 = 2500$.

The architect of the New York State Building at the Panama-Pacific Exposition is Charles B. Meyers, New York City.

Bituminous Filler for Granite Block in Brooklyn

H. H. Schmidt, Chief Engineer of Highways, Discusses Merits of Asphaltic Material and Cement Grout for Pavement Joints

WHILE cement grout as a filler for the joints in a granite block pavement has given excellent results in some places it is the practice in the Borough of Brooklyn, New York City, to employ a bituminous filler. The reasons for this choice were given by H. H. Schmidt, chief engineer of the Bureau of Highways, in a paper presented before section D of the American Association for the Advancement of Science at the Philadelphia meeting, Dec. 30 and 31, 1914.

"My experience has been," Mr. Schmidt said, "that a cement grout filler cannot well be used in busy, growing cities, where pavements are constantly ripped up for the purpose of installing subsurface work. The grouted granite block pavement is very difficult to restore; patches in this pavement are easily discernible, and even mar the looks of the street."

PATCHING PAVEMENT

For the first few years, before the cement grout wears off and before the pavement has been opened to any extent, the pavement laid with the cement grout filler generally looks better and is smoother than the pavement laid with the bituminous joint filler. But Mr. Schmidt's observation has been that after the lapse of a few years the cement grout pavement is generally marred by patching, and further by the fact that the cement grout, which is allowed to a slight extent to cover the blocks, wears off in patches, disfiguring the street to a considerable extent. With a bituminous joint filler, on the other hand, the patches can hardly be seen, and the pavement often improves in appearance after a few years of service.

With modern granite block it is possible to obtain joints averaging from ¼ to ¾ in. The blocks are laid so close together that a considerable area of the blocks touch one another, thus giving stability to the pavement, even without the joint filler. It is not necessary, according to Mr. Schmidt, to fill the small space which is left between these blocks with cement grout, as ample rigidity is obtained with a bituminous filler. It is unnecessary with the modern granite block pavement to use paving gravel, and the modern practice favors the use of a mixture of tar or asphalt with hot sand, poured into the joints.

So many examples of extremely rough and poorly laid granite pavements exist in almost all large cities, that there is a strong prejudice in the minds of many against the use of this class of pavement. The vast improvement which has taken place in its character is not generally known and appreciated. Granite pavement is capable of a still higher development, but block cutters and pavers must be further educated before perfection can be attained. One of the great difficulties is the necessity for eliminating from general use blocks produced by certain quarries where the nature of the granite is such that good results cannot be obtained. The second difficulty lies in the fact that very few pavers are sufficiently careful, and have a sufficiently good eye and judgment to pave the courses with properly selected blocks.

Railroad Operating Income Fell Off 11.5 Per Cent in 1914

GROSS operating revenues for 1914 on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $12,879 per mile, showing a decrease of $1,065 or 7.6 per cent as compared with 1914. Operating expenses were $9,324, a decrease of $703 or 7.0 per cent. Net operating revenues, therefore, were $3,555—a decrease of $362 or 9.3 per cent, and operating income was $2,955—a decrease of $382 or 11.5 per cent. The decreases in operating income for the three main districts were 12.5 per cent for the Eastern district, 15.9 for the Southern and 8.9 for the Western.

For the month of December the average decrease in operating revenues, expenses and net income throughout the United States was 11.4 per cent. Net income decreased 27.0 per cent in the Southern group, however, and only 2.9 per cent in the Western.

PLANT HANDLES CONCRETE MATERIAL FROM BARGE TO CARS FEEDING MIXERS

Concrete Warehouse on Brooklyn Waterfront Rapidly Completed Despite Serious Delays

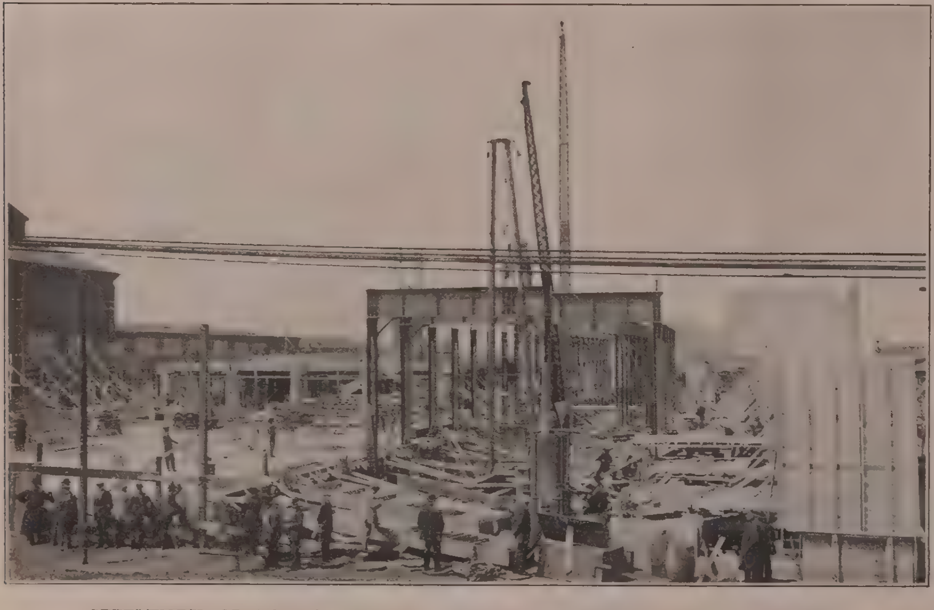
Clamshell Unloading Plant Used in Connection with Water Delivery of Concrete Materials — Buggies Found Cheaper Than Spouting

WHEN a large reinforced-concrete building must be completed by a certain date to avoid heavy penalty, and when unforeseen conditions have seriously delayed the foundation work, the concrete handling and distributing plants must be of the best if time lost on the schedule is to be made up. How this was done on a Brooklyn building was told by T. Arthur Smith, general superintendent of the Turner Construction Company in a paper, reprinted here in part, which was presented at the eleventh annual convention of the American Concrete Institute. The successful placing of 17,510 cu. yd. of concrete between April 11 and July 3, 1914, in sixty-two working days, was due to the efficient operation of the equipment here described. The average capacity of each concrete plant was 45 cu. yd. per hour, and as high as 640 cu. yd. were placed in one day of 8½ hours.

The Austin Nichols Building is situated at the northwest corner of Kent Avenue and North Third Street, extending from the avenue along Third Street to the bulkhead line of the East River. It is 440 ft. x 178 ft. 8 in. in plan, with six stories and basement. The floors are of the beam and girder type. Some of the quantities involved were 24,200 cu. yd. of excavation, 2520 piles (driven to support the west half of the building), 1550 tons of reinforcing steel and approximately 21,000 yd. of concrete. The contract also included all subcontract work, which totaled $340,000 and comprised the structural steelwork over the railroad tracks which entered the first story, elevators, heating, refrigeration, roofing, waterproofing, etc. The contract was awarded Dec. 12, 1913, and called for entire completion Sept. 1, 1914. Failure to deliver the building complete by this date would subject the contractor to a heavy penalty.

Work on the excavation, piling and concrete foundations was prosecuted during December, 1913, and January, February and March, 1914. For concreting foundations a motor-driven mixer of ½-cu. yd. capacity was set up west of the center of the building on North Third Street, the street at this point being about 8 ft. above the general excavation level. The concrete was discharged into a box, from which it was wheeled in concrete carts of 6-cu. ft. capacity to the footings. Adjacent to this mixer was placed a vertical boiler of 25-hp, the steam from which was used to heat water for the concrete, and to thaw out frozen sand and gravel. Over each footing concreted in freezing weather was placed a collapsible framework, covered with heavy burlap, inside of which was placed a salamander burning coke. This method of preventing the concrete from freezing proved entirely satisfactory and made it possible to concrete regardless of temperature. This mixer was used while the excavation, piling, pumping, etc., interfered with the erection of the permanent concrete plants.

Serious difficulties were encountered in excavation and in driving piles, due to the presence of old brick and concrete foundations, cribs, etc. Moreover, severe cold and heavy snowstorms in February materially



STEELWORK SPANNING RAILWAY TRACKS ON FIRST FLOOR OF BUILDING delayed the progress of the excavation and piling, and hence the concreting of the foundations. The driving of piles and the excavation was finally completed April 7, and the foundations finished April 11. To complete the building entirely by Sept. 1, 1914, required that the roof be finished by July 1, and that all concrete work, excepting cement floors, be completed by July 15. This required the placing of 19,620 cu. yd. prior to July 15.

UNLOADING AND CONCRETING EQUIPMENT

Sand and gravel were delivered alongside the bulkhead, adjacent to the storage bins, on scows of about 400-cu. yd. capacity. A derrick equipped with a clamshell bucket of 1⅝-cu. yd. capacity unloaded these scows into storage bins holding 100 yd. of sand and 200 yd. of gravel. It was operated by a standard 9 x 10-in., 35-hp, three-drum hoisting engine. An independent swinging engine was installed. Power was supplied by a 50-hp horizontal boiler.

CONCRETE DISTRIBUTED IN BUGGIES IN PREFERENCE TO CHUTING

The sand and gravel were discharged from the bins into V-bottom, two-way dump cars for delivery to the mixers. Each car was loaded with 12 cu. ft. of sand and 24 cu. ft. of gravel, a steel partition separating the materials. One car was used to convey the material to mixer 1, located at the foot of one elevator, and was pushed by hand from the storage bin to the mixer. For charging mixer 2, located at the other elevator, a double track of 2-ft. 6-in. gage was laid from the bins to the mixers; on it two cars were operated, one on each track. The tracks were laid on the first floor, which, in order to follow the grade of North Third Street, sloped down 8 ft., from Kent Avenue to the River. A double-drum motor-driven hoist pulled the cars from the bin to the mixer. These cars were connected by a tail line operating around a sheave at the bin, so that the loaded car going down toward the mixer would pull the empty car back to the bins. Owing to limited bulkhead space at the building, it was necessary to dock the cement lighters one block away and truck the cement to the building. Cement was stored near each mixer. Six bags were used to a batch.

Two 1-cu. yd. mixers were installed, discharging directly into buckets holding one batch each. The buckets were operated with single-drum hoists. Power for each concrete plant was furnished by a 75-hp motor. From the hoist bucket concrete was dumped into a 2-cu. yd. box on each floor, from which it was wheeled in concrete carts.

CHUTES VERSUS CARTS

The use of spouts for placing concrete was carefully considered. Records of the cost of wheeling concrete on similar buildings showed that this cost did not exceed 9 cents per cubic yard. This is based on labor at 37½ cents per hour. Assuming that of the 19,620 cu. yd. of concrete to be placed, 16,000 cu. yd. could be placed by spouting, the cost of wheeling saved by this spouting would be 9 cents × 16,000 or $1440. Hence $1440 would have to cover the cost of installing two spouting outfits and also the cost of raising the tower the additional height, guying the tower, and moving the spouts. Analysis showed conclusively that for this building, the cost of the spouting equipment, plus the additional installation cost, would materially exceed the cost of wheeling.

EQUIPMENT FOR HANDLING REINFORCING STEEL

Steel was delivered in cars on the track adjacent to the steel yard. In unloading care was taken to place in separate piles all steel to be bent. The bending equipment installed consisted of one machine for bending beam and girder bars and one machine for bending stirrups, together with one shear capable of shearing 1-in. square bars. These machines were driven by a 15-hp motor. As steel was required, it was placed on standard-gage hand-cars and pushed to one of the steel hoists. The two hoistways were 4½ ft. square and were sheathed on all sides with 2-in. plank. Over each hoistway, on the floor in course of construction, was placed a gin-pole, 25 ft. long, to which was attached a tackle for hoisting the steel. The hoisting was done by single-drum motor-driven hoists, located one near each hoistway on the first floor.

HANDLING FINISHING MATERIALS

The cement floors throughout the building consisted of a top coat of cement mortar, ¾ in. thick, placed on a cinder concrete base, 2½ in. thick. Grit, which was used in the mortar, was delivered on scows at the dock used for receiving cement. Cinders were obtained from factories in the neighborhood. These materials were trucked to the building and stored on North Third Street. The cinder-concrete base and the cement-top coat were mixed and hoisted in the same manner as the gravel concrete, the cinders and grit being wheeled to the mixers.

The hollow tile, for partition construction, was delivered on lighters, unloaded adjacent to the sand and gravel bins, and piled on the first floor near the platform hoist. This hoist, which was placed in an elevator shaft, consisted of a platform, 5 ft. 6 in. square, operated by a single-drum motor-driven hoist. Tile was handled on it in wheelbarrows. The erection of the tile partitions followed closely after the completion of the cement floors.

INFLUENCE OF LAYOUT ON ERECTION

The successful erection of this building was due to the efficient operation of the equipment herein described. All foundation work was finished April 11, and the roof was completed July 3. Between these dates 17,510 cu. yd. of concrete were placed in sixty-two working days, an average daily output of 282 cu. yd. The derrick was capable of unloading 700 cu. yd. of material per day of eight hours. The average capacity of each concrete plant was 45 cu. yd. of concrete per hour. The largest quantity of concrete placed in one day of eight and one-half hours was 640 cu. yd. The efficiency of the equipment for conveying materials from the bins to the mixers was demonstrated when, due to a slight breakdown, the derrick was idle for one day. In order to keep one mixing plant in operation, sand and gravel were wheeled from emergency storage piles on North Third Street. To charge one mixer in this way required twenty-two additional men, and reduced the output of the plant to about 30 cu. yd. per hour.

In order not to delay the progress of the work, it was necessary that the reinforcing steel be placed immediately after the completion of the forms. This required that work in the steel yard be so systematized that the bending and fabrication would be sufficiently in advance of requirements to prevent delay. Beam and girder bars were bent at an average rate of 125 per hour, while the capacity of the stirrup bender was 4000 per day.

The total labor cost for installing all equipment used in the erection of the building amounted to 20 cents per cubic yard of concrete. It must be borne in mind, however, that this cost does not cover any charge for material, or use of plant, depreciation, or interest on equipment investment.

The building was erected for Havemeyer & Elder, and leased by them to Austin Nichols & Company, wholesale grocers. The Turner Construction Company executed the general contract under the direction of Cass Gilbert, architect.

SEWERAGE SYSTEMS HAVE BEEN INSTALLED in only 28.5 per cent of the incorporated cities, towns and villages of the Province of Ontario. In his report for the year 1913, recently made public, F. A. Dallyn, provincial sanitary engineer, says that of 276 towns in the province, 184 have fire-protection or water-supply systems, and seventy-nine are provided with sewers. In the sewered towns 40 per cent of the population remains unconnected to the sewerage systems. The typhoid death rate for the province is 24.4 per 100,000 population.

Wood Block Replaces Plank as Steel Bridge Flooring

Five Years' Experience in Tuscarawas County, Ohio, Indicates Superiority of New Type of Construction on Old Bridges

By EDWARD STINGEL
Civil Engineer, New Philadelphia, Ohio

To those charged with the responsibility of maintaining old steel highway bridges has come, no doubt, a full realization of the desirability of a better type of bridge floor other than that of common plank. Plank floors are at best a makeshift, expensive and difficult to maintain in a safe condition for public travel, although they may be economical on old bridges with a very light traffic. Moreover, if the plank are not graded with great care when laid a few will decay and develop defects long before the floor becomes generally bad. This repairing is done by a local supervisor who usually places a patch over each defect, subjecting the traffic and also the bridge to a series of shocks and jolts.

Plank floors naturally divide themselves into two classes—those that wear out by traffic, and those that fail by decay. Of the latter type a 3-in. number one, white oak floor may last from 6 to 10 yr., and of the first type the life is regulated by the kind and amount of traffic.

The object of this article is to review what is being done by Tuscarawas County, Ohio, in replacing plank floors on old steel bridges where the traffic is sufficiently heavy to cause plank failure after 2 to 5 yr. wear.

PLANK FLOORS A FAILURE

It is increasingly more difficult, in this locality, to secure number one, white oak plank. Therefore red oak plank are occasionally used, and in some cases hickory and beach, both of which have proven failures because of their tendency to decay. Double floors have been discarded because of the tendency to retain moisture between the layers. Occasionally a double floor is used in a case where the old plank are badly worn but sound; then a 2-in. plank floor laid longitudinally may be economical.

Five years ago this county laid its first wood block floor on an old steel bridge, and since then more than 8000 sq. yd. of this type of floor have been laid, and those in authority believe that the floor problem, in so far as it affects old steel bridges, has been solved. Most old steel highway bridges are of the pin connected type with a loose, wabbly, suspended floor system. The vibration in many cases becomes a sway when crossed with a heavy load because of the loose construction of the floor system.

A wood block floor on this type of bridge has the very desirable effect of stiffening the structure to a very decided extent. In fact, the floor system behaves more like that of a solid riveted structure. This gives a sense of security which is desirable, and the bridge is not subjected to the severe jolting and racking as is the case under the old conditions.

SPECIFICATIONS

The methods of block manufacture, creosoting, laying, etc., are covered by detailed specifications of which a few excerpts are here given:

Plank.—The plank shall be 3 in. thick after being surfaced, 10 in. wide and shall be in length equal to the full width of the floor. The wood shall be regular commercial yellow pine, which shall be free from knots or other defects. A minimum of six annual rings to the radial inch shall be required of all lumber and block.

Block.—All block shall be 3 in. deep, 3 in. wide and 6 in. long and shall be cut from lumber as above specified. They shall be rectangular and uniform in size, and shall be dressed on one side. No block shall vary in width and depth more than 1/16 in. from the specified size.

Creosoting.—All plank, nailing strips, curbs, blocks and all other wood used shall be creosoted with 18 lb. of creosote oil per cubic yard of wood.

Creosote Oil.—The creosote oil shall be a dead oil of coal tar or coal tar product. It shall not contain more than 3 per cent of water and if it does contain this amount of water a corresponding correction must be made so that an equivalent additional amount of creosote is forced into the wood. It shall contain only traces of acetic acid and acetates. Its specific gravity at 100 deg. Fahr. shall be at least 1.03 and not more than 1.07 so as to assure its thoroughly penetrating the wood block. The residue insoluble by filtration with benzol and chloroform must not exceed 3 per cent of the weight of the creosote oil. Fractional distillation of 100 grams of the creosote oil shall produce percentages of dry oil by weight within the following limits:

Up to 150 deg. C.	not to exceed 2 %
Between 150 and 170 deg. C.	not to exceed 1.5 %
Between 170 and 235 deg. C.	not to exceed .35%
Between 235 and 300 deg. C.	not to exceed .35%

The residue remaining shall be soft and adhesive. The creosote oil shall contain about 25 per cent of crystalizable napthalene and at least 15 per cent anthracene oils. At least 95 per cent of the creosote oil shall be soluble in carbon-bisulphide and equally in absolute alcohol.

INSPECTION

Creosoted wood, even with an 18-lb. treatment, will show uncreosoted near the surface when cut into in some cases. Considerable trouble has been had in the lack of uniformity in creosoting, and especially is this true of plank. To overcome this the specifications now provide that any plank or timber showing uncreosoted wood ½ in. from the surface at any point will be rejected. All plank and other timbers are tested by boring each piece at least in two places.

If the creosoting has been superficial only the piece is rejected. Whenever any creosoted wood is cut for any reason the exposed surface is given one coat of red lead and oil for protection, as lumber is made antiseptic by the creosoting process and should be so maintained. The inspection should also include an inspection at the creosoting plant for the sake of harmony between the engineer, manufacturer and contractor, even if there were no other good reason therefor.

DETAILS OF CONSTRUCTION

Steel stringers are used in all cases; if the old stringers are wooden new steel ones are provided. Old steel stringers are carefully inspected, and especially where they rest on abutments and piers where deterioration will be more advanced than elsewhere. The crown of the roadway is made by placing steel or cast plates of varying thickness under the stringers. The stringers are bolted through these plates to the floor beam flanges with ⅝-in. bolts. The slope of the crown is 1/6 in. per foot. Two nailing strips are used on an 18-ft. roadway and the ends of the plank and the curb are held in place with ⅝-in. hook bolts, spaced 5 ft. on centers, hooked under the bottom flange of the side stringers. The open curb to provide for drainage is preferred over the solid curb and scupper plan. The 4 x 6-in. creosoted curb is elevated above the block surface by creosoted wood blocks, 2 x 6 x 6 in., spaced 5 ft. on centers, which allows the water and refuse on the roadway to escape quickly. The solid curb and scupper plan has been found unsatisfactory because of the tendency of the scuppers to become clogged and closed, causing the water to follow the curb, spill over the approaches and wash ruts along their slopes.

UNIFORMITY OF BLOCKS

Blocks of uniform size are specified, as they make a neater floor and less care need be exercised in laying them. Much variation is noted in the density of the wood and unless the specifications are rigid in this respect some trouble may be experienced. Six annual rings per radial inch are specified. Many blocks will run, by this specification, from ten to fourteen rings per inch. This is also required of plank and other timbers. Uniformity in creosoting of block seems to be more easily secured than of plank and heavy timbers. This, no doubt, is caused by the tendency of the oil to follow the grain of the wood. The block being shallow the penetration is easily secured.

After the plank have been inspected, checked for thickness, laid and spiked with 60-penny spikes, the block are laid upon tarred felt of one-ply thickness, which is unrolled upon the plank immediately in front of the block and is run transversely with the roadway. The blocks are laid loosely, square across the roadway, with an expansion joint along each curb of one inch in width for an eighteen foot roadway or less, and correspondingly increased if the roadway is wider. A soft pitch filler is used, and is applied in two applications by pouring and brooming. The pavement is then covered with a coarse sand or pea gravel. Granulated slag has also been used and has met with approval. These floors have been laid on grades up to 3 per cent. No trouble from bulging has been had, and no wear is noticeable.

MAINTENANCE AND COST

There has been no maintenance cost charged against any floor since being laid. The cost to the county, under contract, has been from $4 to $4.75 per superficial square yard, for the work completed, including metal risers, cleaning and painting of the stringers.

THE BOSTON ELEVATED RAILROAD during the last fiscal year covered 57,990,436 car-miles and carried 343,181,049 passengers without a fatal accident. During the same period five persons were killed in attempting to leave surface cars in motion, but these accidents were judged to have occurred through no fault of the company. For this record the Anthony N. Brady medal for promoting the public safety was awarded the railroad.

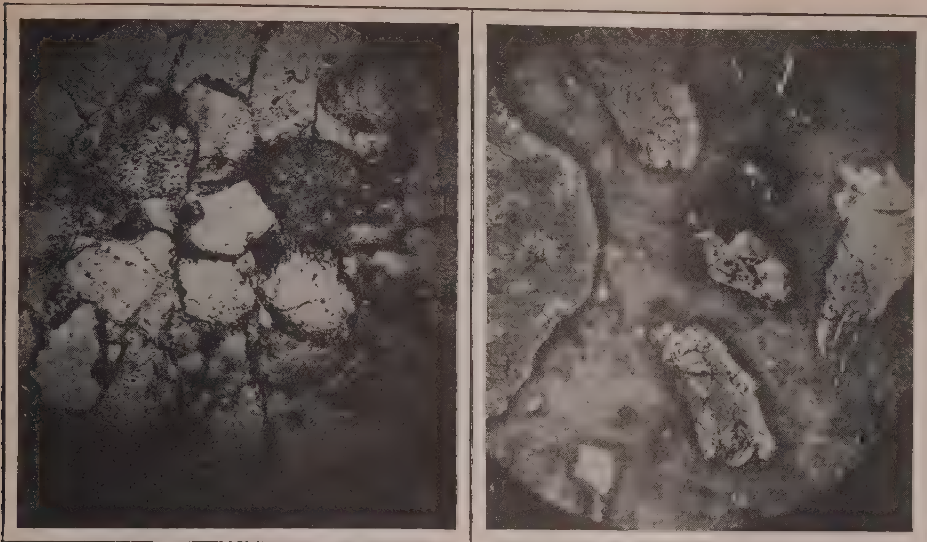


FIG. 22A—MEDINA SANDSTONE FIG. 22B—CONCRETE FROM HAWAIIAN PIER

200 Diameters

Microscope Shows Importance of Mixing as a Factor in Making Strong Concrete

Fifth Article in Series of Six—Size of Aggregate and Quantity of Water Used Also Influence Strength of Mixture

By NATHAN C. JOHNSON
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IN Article 3, the proportioning and grading of aggregates was shown to have a pronounced effect on the quality of concrete. Sections taken through specimens moulded from mixes of varying proportions showed varying stone content and arrangement, with consequent greater or less thickness of cement layer. The necessity of proportioning cement according to the burden imposed by each particular aggregate was emphasized by reference to these test results. However, all difficulties with concrete cannot be blamed upon improper proportioning of aggregate. There are other factors equally vital which receive as little, or even less attention; and these are to be the subjects of the present paper.

STONE AND CONCRETE COMPARED

It has been previously stated that a product having a density equal to that of natural stone is an ideal concrete. It has been shown, also, that the high density of natural stone is due to close compacting of the components, with the cementing substance between them present only in the very thinnest layers. On the other hand, it has been shown that the component particles, large and small, of our inferior artificial concretes are widely separated; and that the layers of cementing substance—usually the weakest element of the combination—are correspondingly thick, with a proportionate percentage increase of air and water voids in the mass.

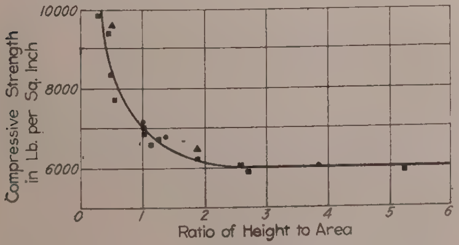


FIG. 23—RELATION OF COMPRESSIVE STRENGTH TO THINNESS OF SECTION

In order to emphasize this difference, a microphotograph of a natural concrete (Medina sandstone) and another of an artificial concrete, the latter made under U. S. Government supervision, with graded aggregate, and presumably with the best materials and by the most approved methods, are placed side by side in Fig. 22. Both photographs show equal magnification—200 diameters. No effort was made to exaggerate differences by choosing a poor section of surface for the concrete, or a good one for the stone. Rather, if any partiality was shown, it was in favor of the concrete.

CEMENT COMPONENT

With this comparison in mind, consider for a moment the qualities of the cement component of any concrete. Of all the ingredients, cement is the most expensive and the most subject to chemical attack. Further, in most concretes, it is inherently the weakest portion; and the paste of cement and water is *the only part in which injurious air can be entrained.* Obviously, the less there is of it, beyond a certain necessary minimum, the stronger and the cheaper will be the concrete.

Neglecting other factors for the present and considering only the strength of the cement matrix, the reduction of the thickness of cement layer by closer compacting of aggregates has the same effect as shortening a column of given section, i. e., it will stand a greater load per unit area. This effect is well known; and a curve for sandstone, but characteristic of other materials as well, giving the relation between load sustained and the ratio of height to sectional area, is shown in Fig. 23, which is taken from Upton's "Structure and Properties of the More Common Materials of Construction." As this ratio of height to area approaches zero, the strength approaches infinity, so that the thinner the layer, the greater its supporting value; and the thicker the layer, up to a certain point, the lower its supporting value.

This truth has an interesting and easily demonstrable application in cement testing. Varying thickness of cement layer is probably the main reason that standard tests of the same cement and the same aggregate made by different operatives are usually so discordant as to be practically useless as bases of comparison. Different men possessing different degrees of muscular strength produce different thicknesses of the cement layer between the sand grains, or, if the expression be preferred, produce closer compacting of the sand in the briquettes, with the result that a certain allowance has always to be made for the "personal equation." This also relates back to the superior strength shown by the Fuller's curve concrete in Article 3, in which increased percentage of graded stone particles necessitated thinner layers of cement matrix. But assuming proper grading and proportioning of materials, there is yet much to be accomplished in producing good concrete.

Theoretically, at least, if not actually, the dry ingredients—sand, stone and cement—are capable of forming a dense mass by the finer particles filling progressively the spaces between the larger. But the ultimate positions of even the most perfectly graded sand grains and stone particles in a concrete are dependent upon the manner of its mixing and placing. In just what manner these affect the final result is so far a matter of conjecture only. To discover the effects, the purely physical actions involved in wetting a dry substance with water will be investigated.

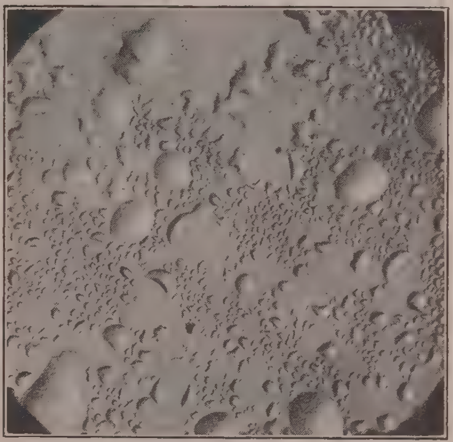


FIG. 24—WATER SPRAYED BY ATOMIZER

15 Diameters

SHAPE OF WATER PARTICLE

The physical characteristics of a piece of stone, or of a grain of sand, or of a particle of cement, are quite generally known within reasonable limits, but the form of a free particle of water may be less familiar. The spray from an atomizer, projected vertically and falling on a microscope slide, is shown in Fig. 24, magnified about 15 diameters. It is evident that each water particle, large or small, is a sphere, or that each at least tends to assume the spherical form. Further, the surfaces of each spherical, or spheroidal, particle must resist gravity to maintain that form, as the center is obviously higher than any of the other portions. To judge from the tucked-in look of the "edges," where the particle meets the glass slide, there might almost be a tough skin on each particle, holding the interior from flowing away. Certainly, there is pressure against the bounding surface from within, so that there must be a corresponding pressure inward from without to maintain equilibrium. So much is self-evident.

Curiosity as to the effect of such water particles mixed with sand particles prompts further investigation. Some dry sand (Standard Ottawa sand) of known size, put on a microscope slide and tapped to secure close packing, shows as in (a), Fig. 25. Using the atomizer as before, but catching the drops on the slide covered with sand, shows no effect at first, but when the water drops are in sufficient number to unite, they do it with such a rush that the sand grains, weighty as they are, are pushed and pulled much closer than it was possible to place them when dry. Further, they are held tightly in place by that stressed "skin" of the big water drop inside of which they lie, as in (b), Fig. 25, so that it is difficult to move them. If, however, the miniature rain from the atomizer is continued, there comes a time when the center of the water sphere has risen to such a height that its weight is greater than the resistant pressure; and when this occurs, the drop disperses and the sand grains rush apart, singly or in groups, with as much intensity as they previously came together, so that no pushing or pulling can arrange them as they were a moment before, as the water itself now insists on occupying space between them. This is shown in (c) Fig. 25.

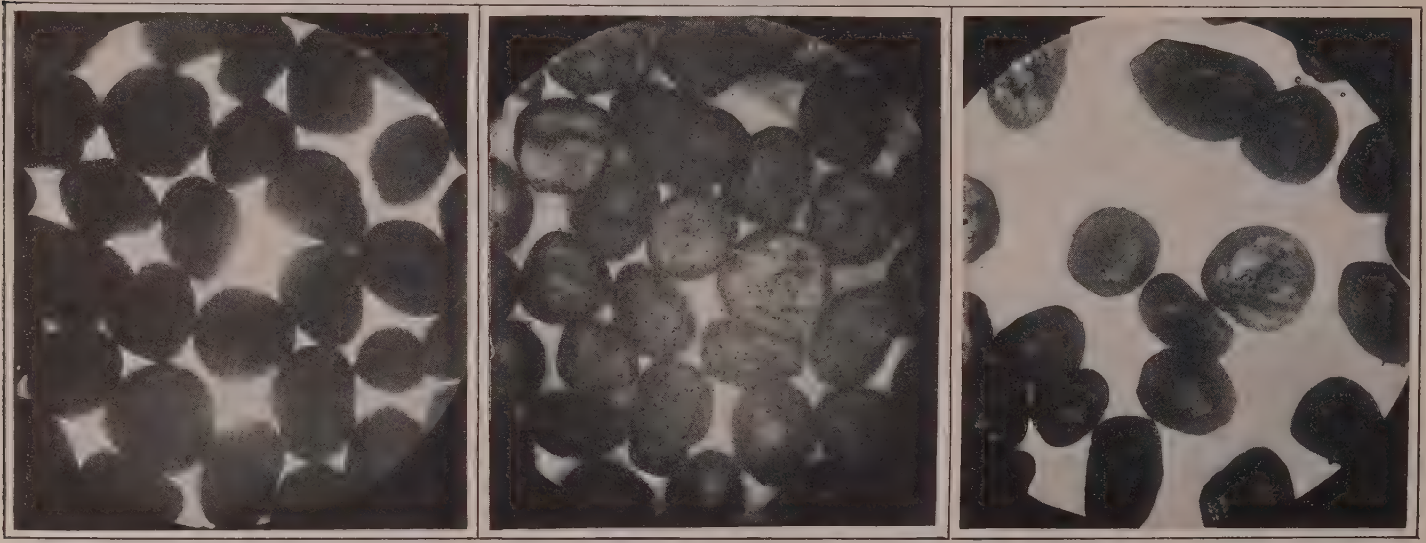


FIG. 25—MICROSCOPE SHOWS EFFECT OF SMALL AND LARGE ADDITIONS OF WATER TO DRY SAND; 15 DIAMETERS

(a) Ottawa sand, dry (b) Sand and little water (c) Sand and excess water

SURFACE TENSION

This tendency of water to assume the spherical form is universal (as witness rain drops); the interaction of forces that produce this effect is known as "surface tension." Further, as its name implies, there is an actual *surface tension,* or "skin effect," exhibited by the water, and in mixing concrete, whether by hand or by machine, in batches large or batches small, it is constantly in action. This is one of the main causes for the separation of aggregate, the cause of which was sought. If taken advantage of, the surface tension effect may be of great use in concrete mixing, but if disregarded, it proves detrimental to an equal, if not to a greater, degree.

In the foregoing demonstration, Standard Ottawa sand, although rather coarse, was chosen because it is graded to known size. If the effects thus exhibited on standard sand were taken as a basis of comparison, it is obvious that particles of lesser size, such as fine sand grains, would be more easily moved, and that particles of greater size, such as large sand grains, or stones, would be less easily moved by any given force.

VOLUME OF SAND WITH DIFFERENT PERCENTAGES OF WATER

This has an everyday application closely related to concrete mixing, in the compacting of sand of different grades. The relation between volumes and percentages of water for sands of varying degrees of fineness, as determined by experiment, is shown in Fig. 26, taken from the report of the Chief of Engineers, U. S. A., 1895, page 2935. It is hardly necessary to point out that the compacting is most marked with the finest materials, or that both the fineness of the material and its moisture content bear directly on the proportioning of concrete. Obviously, the more compact a material, the greater the quantity that will be contained in a given measure, such as a box, or a wheelbarrow. Further, a moment's thought brings the conviction that this surface-tension effect, being most marked with fine materials, must bear directly on the grouping of cement particles which has been an observed characteristic of the concretes thus far studied. It must also largely determine the internal structure of a concrete made with fine sand; and corollary to this, the amount of water used in mixing must have a very pronounced effect on the quality of the concrete. These are new complications not usually considered, but they may prove worth investigation.

Consider, first. the use in a concrete of a very fine sand, or a non-adhesive silt. The material might reasonably be expected to be of great value in producing a dense concrete, both by filling voids and by stopping minute pores. It is, however, frequently the case that fine materials such as these *remain wholly untouched by cement.* The initial addition of water brings the fine particles closely together in the manner already demonstrated and either subsequent additions do not reach these groups in sufficient quantity to exert a dispersive effect, or else *the mixing process is cut short,* so that mechanical dispersion is not effected by the grinding action of the coarser materials in the mixer. The result is that these groups, often constituting a very considerable portion of the mass, are held in place only by the confining action of adjacent portions, which, in turn, may themselves be either wholly or partially composed of uncemented materials. In such cases, the fine particles have doubly failed of their purpose, for not only are they not distributed as void and pore fillers throughout the mass, but they remain wholly without contact with cement, so that they constitute a rotten spot in the concrete.

This condition is not fanciful. It is frequently met with in field concretes, though it is not often recognized. Fig. 27(a) shows a microphotograph of such a concrete, taken from a chimney foundation built by a reputable and painstaking firm of engineers. Fig. 27(b) shows a concrete of similar nature taken from a bridge pier, put in by an equally conscientious contractor. The magnification used in both cases is but 15 diameters, in order to show as much of the aggregate as possible in the limited field of the microscope, but in each it will be seen that the matrix is practically gone from between the larger sand particles; and that the pockets where the finer sand grains lay before they fell out, by reason of being quite uncemented, are distinctly visible. It may be added that the writer knows of no way of determining the presence or absence of such conditions as are here shown, so readily as with the microscope, with the incidental preparation of grinding and polishing the specimen. Other methods of observation obscure rather than reveal defects of this character.

It will probably be said that these are unusually bad cases, especially chosen to emphasize the worst possible conditions and that proper care would have rendered such results impossible. If such were the case, it would be a distinct pleasure to acknowledge it, but it is unfortunately a matter of first-hand knowledge, not of conjecture, that similar conditions are only too prevalent, not only in inferior concretes but in costly and important structures as well.

INSUFFICIENT MIXING

The underlying reasons for a product such as the foregoing are not so much the character of the materials themselves, as the all-too-prevalent practice of mixing concrete an insufficient length of time. Unlike the relatively small groups of cement particles, these larger groups of sand grains can be broken up by the mechanical agitation of mixing, provided the process is continued for a suitable length of time. It is often the case that in the undue haste of supposed efficiency, concrete remains in the mixer drum for only 40 seconds, or perhaps for even less, with sometimes the raw materials pouring in one side before the "mixed" materials have cleared; and because the output looks as much like grey mud as the inspector deems sufficient, it goes into the forms in a final aerating splash that augurs poorly for the completed structure. Eternal vigilance and attention to details are the prices of success in concrete work.

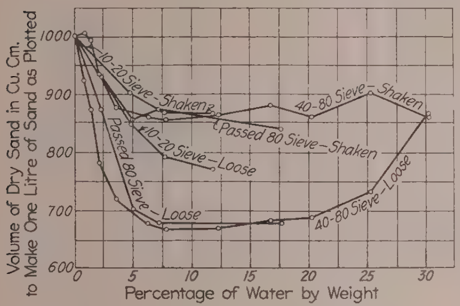


FIG. 26—RELATION OF VOLUME OF SAND TO WATER CONTENT

The question of consistency is also a vital one, though as a general rule, little or no attention is paid to it. A moment's reflection should convince anyone that the amount of water present in a concrete must have a pronounced effect upon its quality. All of the water added must occupy space in the mass unless used in hydration, or evaporated, or drained off. A certain quantity is required for chemical union with the cement; a certain quantity is necessary to wet the surfaces of the aggregates; and any quantity beyond these two, plus a certain percentage necessary to render the mass sufficiently fluid for convenient handling and proper contact with moulds and reinforcement, is a distinct detriment. This detrimental effect may be due to many causes, but it is probable that separation of fine aggregate (with consequent separation of the coarse aggregate) as before demonstrated, the production of excessively large air and water voids, the production of shrinkage cracks, the formation of excessive laitance, and the washing away of fine cement are those in the main responsible.

The importance of proper consistency is quite susceptible of proof. Even if all other factors affecting quality and strength were inoperative, the water voids due to excessive wetness are sufficient of themselves to exercise a most pronounced effect. *Every 62½ lb. of water weight in concrete occupies one cubic foot of space; and every cubic foot of water lost by evaporation or drainage means one cubic foot of voids remaining in the mass.* In Fig. 28 is shown a series of curves plotted from data obtained by the American Concrete Institute from experiments conducted at several universities. The difference in strengths of wet and dry concretes is very striking. (See also H. F. Porter, Cement Age, June, 1912; M. O. Withey, Permeability Tests of Gravel Concrete, Engineering News, Oct. 22, 1914, p. 811.)

So far as the writer's investigations have gone, the effect of surface tension, both in the ways outlined in this article and in others not mentioned, seems to be one of the principal detriments to the production of strong, dense concrete. The effectiveness of the entire mixing process is essentially a function of greater or less differences of surface-tension between the constituent materials, and by proper attention to this factor, decidedly superior results have already been produced, with, it is hoped, better ones shortly to follow.

SUMMARY

Summarizing this article, it should be noted:

1. That the difference between natural and artificial concretes in thickness of cementing layer, or, if it is preferred, the compacting of aggregates, is extreme.

2. That since the cementitious constituent is the most expensive, the most subject to attack, and (as a paste with water) the only constituent of concrete in which injurious air can be held, the less there is of it, beyond a necessary minimum, the better will be the concrete.

3. That such thickness of an inherently-weak layer is very undesirable in a structural material, as the thinner such a layer can be made, in proportion to the area under stress, the more nearly will it approach in strength the strength of the surfaces by which it is confined, i.e., the strength of the aggregate, and the more homogeneous and the better will be the composite product.

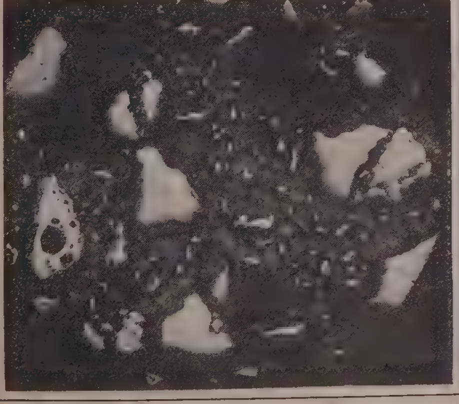


FIG. 27A—CONCRETE FROM STACK FOUNDATION

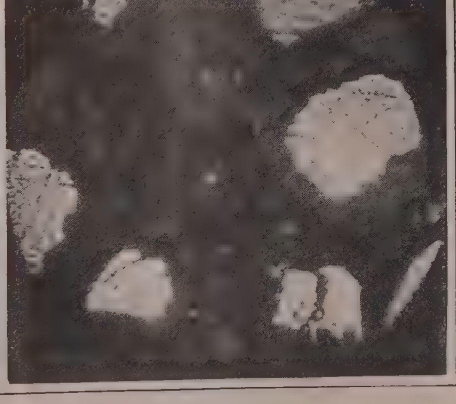


FIG. 27B—CONCRETE FROM BRIDGE FOUNDATION

Magnification, 15 diameters. Black, foggy spaces show where particles untouched by cement lay before falling out.

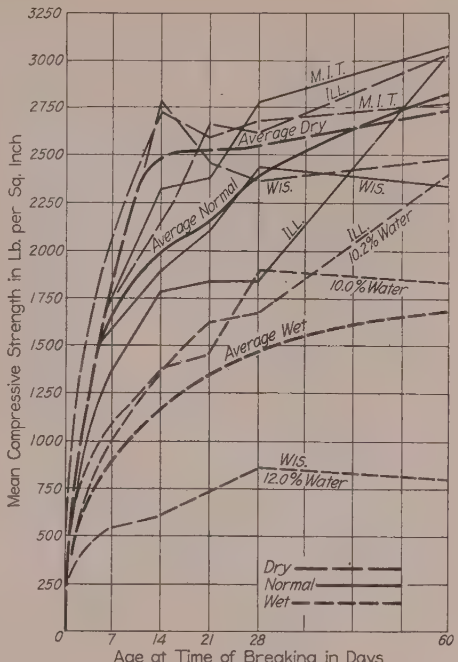


FIG. 28—TIME-STRENGTH CURVES FOR CONCRETES MIXED WITH DIFFERENT PERCENTAGES OF WATER

4. That this fact demonstrates the reason for dissimilar results being obtained in cement work with tests of the same materials by different operatives, i.e., the reason for the "personal equation."

5. That among the causes of this universal, wide separation of aggregates in concrete, the physical actions involved in mixing a dry substance with water are the chief.

6. That a dry substance, such as sand, when moistened, compacts more closely than when dry, until a certain percentage of water is added, because of "surface tension"; but that when this percentage of water is exceeded, the action is reversed and dispersion results.

7. That the finer the material, the more pronounced the effect of surface tension; and the coarser the material, the less pronounced the effect.

8. That because of this action, very fine aggregate lumps together and remains quite untouched by cement, so that weak spots of uncemented materials are frequently found even in concrete placed in the most important structures.

9. That this grouping can be broken up to a greater or less extent by prolonging the mixing operation, but that where materials are mixed for only a few seconds in order to obtain an abnormal output, inferior if not positively defective concrete must be the result.

10. That consistency of mix is a vital matter, though commonly given little attention, as not only is the compacting of aggregate prevented by an improper amount of water and undue thickness of weak material obtained, but further evils are introduced thereby, such as unduly large voids, excessive laitance, shrinkage cracks, segregation of materials of different grades, and the washing away of cement.

The sixth, and final, article of this series will appear in next week's issue.

New Type of Gate for Regulating Adjacent Water Levels Operates Automatically

Structure Supported on Arms or on Arms and Rollers Is Used by the Department of Drainage, Province of Buenos Aires, Argentina

A NOVEL type of automatically operated regulating gate has for some years been used by the Obras de Desague de la Provincia de Buenos Aires, Argentina. So far the gate has only been placed in drainage canals, but it is also readily adaptable as a movable crest for dams. The design is based on the principle of momentary points of rotation, so that for each rise in water level, dh, above a predetermined elevation, the gate has a rotation dφ in respect to a momentary point. Consequently, when the gate is full open, that is, when the water level has risen a height h, it has turned an angle φ and the point of rotation has traveled a distance s along an arc. To prevent the gate from overtravel, and to insure the automatic closing, a stopping arrangement limits the tilting of it.

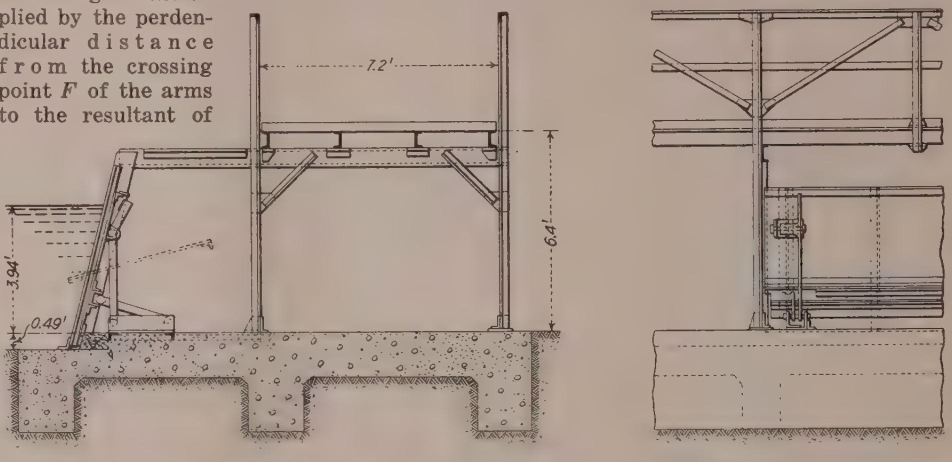
EXPLANATION OF DIAGRAMS

As shown in the accompanying diagrams, a plane gate is mounted on two sets of arms. The first diagram shows these arms mounted on the back of the gate. In this case the gate is double-acting and will open under back pressure. As can be seen from the diagram of the mounting of the gate, the back pressure required to operate it is considerably smaller than the pressure on the front of the gate. Should pressures exist on both sides of the gate at the same time, the only difference in operation will be that the gate opens a little sooner. The second diagram shows the same gate, but modified so as to make it collapsible. This has been accomplished by providing a shoe at the lower end of the rear arm, so that by pulling the arm out of this shoe, as is done by Chanoine wickets, the gate can be laid down. In the third diagram is shown the mounting of the arms on the back of the gate.

A modification of this gate so as to make it open for back pressures only is shown, the only difference between them being a modification in the arrangement of the lever arms.

FORCES AND LEVER ARMS

The forces acting on the gate, expressed in moments, with the intersection F of the arms as center, are: (a) Weight of the gate multiplied by the horizontal projection of the line from the center F to the center of gravity of the gate; (b) water pressure on the gate multiplied by the perdendicular distance from the crossing point F of the arms to the resultant of the water pressure. The gate is preferably designed in such a way that the moment in case (a) always remains a closing factor. The moment in case (b) will be a closing factor for water levels having a resultant pressure falling below the point F. For water levels having a resultant above this point this moment will be the opening factor. This is true for the gate in closed as well as open position up to a nearly horizontal plane, because the center of rotation F moves simultaneously and in proportion to the travel of the resultant of the water pressure.



TWO LEVER ARMS ARE USED IN THE ORIGINAL FORM OF GATE

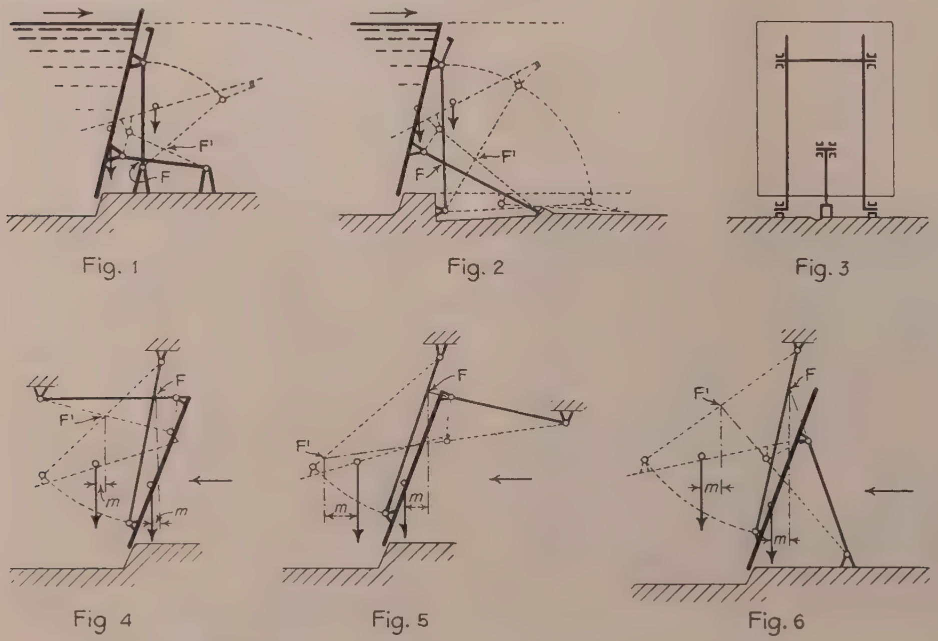


Fig. 1 Fig. 2 Fig. 3

Fig 4 Fig. 5 Fig. 6

DIAGRAMS SHOWING VARIOUS WAYS OF MOUNTING LEVER ARMS

The nearly vertical arm has an extension which serves to limit the tilting of the gate. At the upper end of this extension an adjustable piece is provided, so that the opening can be increased or decreased.

TIGHTENING

When the gate is closed and the water level is lower than that required to open it, the gate must be tight. Along the sill this is a comparatively simple matter, as the water pressure holds the gate firmly against its seat. Along the sides, however, several methods have been tried. One employs a half-round wooden bar mounted on the gate by steel clips and held to it by bolts. The holes in these clips are slotted and inclined, so that when the gate is closed gravity forces the bar in an outward direction, thus covering the joint. The pressure of the water then forces the bar against the gate and the sides of the pier, making the joint practically watertight.

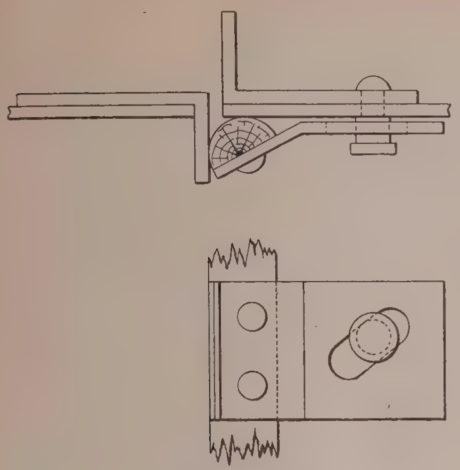
Another method involves the use of wooden sills bolted to the piers. To permit the gate to operate these sills must be cut in two parts, the lower being placed on the rear of the gate below the point where the curve described by the gate when opening intersects the line of tightening, and the other being in front of the gate above this point of intersection. This method leaves a short length of the ends without any seal.

One of the accompanying drawings shows the details of the gate adopted by the Obras de Desague. Before this type was adopted a model 18 in. high was built, and the success of the experiments led to the adoption of the type.

MODIFIED TYPE

The designer, however, has made a modification of this type, in which he eliminates the lower arm and substitutes a roller and a piece of curved track. The detail of the gate is shown herewith, and it operates in exactly the same way as the other types. This gate opens for pressure on either side.

The object of using the rollers instead of the lower arms is to have the gate open with a bigger level arm for back pressures. When the back water is at an elevation giving a resultant pressure located above the intersection F the gate mounted on arms will not open. Such a case can exist if the water on both sides of the gate has risen at about the same rate until a level giving resultants above the intersection F has been reached. If then the water on the front recedes it will leave the gate in a condition where it will not open for the existing or



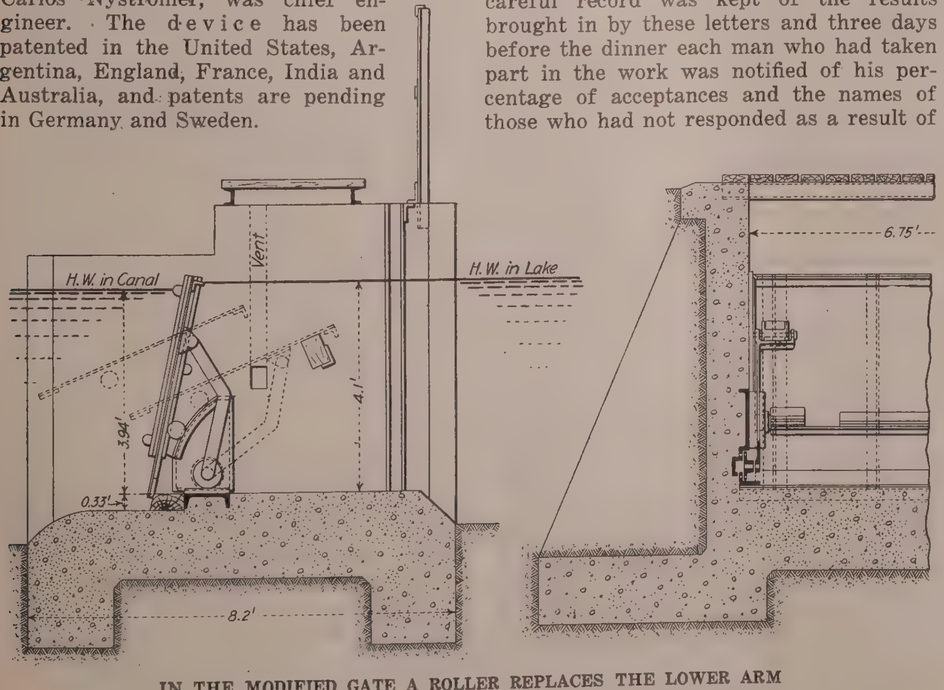
DETAIL OF SEAL

higher back-water levels. When the back-water level sinks the resultant will soon reach a point where it will open the gate. The roller gate, however, having a lever arm for back pressure with its fulcrum located near the top of the gate, will open for all back-water levels.

Nine gates of the roller type are now in operation, their widths being 6.58 ft. wide and the height of water level 3.94 ft. More than 100 gates of the types shown in detail are in course of construction.

The principal applications of these gates in Argentina are: Regulating the level of a body of water; serving as automatic flash-boards on spillway gates; regulating, when double acting, the comparative levels of two bodies of water, such as a canal passing alongside lakes or reservoirs—diverting water from the canal into the lake when the canal is above maximum level only, but directing the flow in the other direction whenever the canal is lower than the lake; and providing a balanced gate permitting the flow of water in one direction, but preventing it from flowing the opposite way, as in drainage systems.

The inventor of the gate is a Swedish engineer, L. G. Larson, who for several years has been in the employ of the Obras de Desague de la Provincia de Buenos Aires, of which the late Swedish engineer, Carlos Nyströmer, was chief engineer. The device has been patented in the United States, Argentina, England, France, India and Australia, and patents are pending in Germany and Sweden.



IN THE MODIFIED GATE A ROLLER REPLACES THE LOWER ARM

Organized Enthusiasm Doubles Convention Attendance

Carefully Planned Campaign Enables Western Society of Engineers to Hold Most Successful Meeting in Its History

ORGANIZED enthusiasm was responsible for an attendance of 400—double the usual number—at the annual dinner of the Western Society of Engineers in Chicago in January. The methods by which this result was achieved are explained in the latest number of the society's "Journal." They should interest secretaries or committees of other engineering organizations who are charged with making arrangements for conventions.

In the beginning an attendance of 400 at the annual dinner was adopted as a slogan by the committee in charge. This meant an increase of 50 per cent over all other records. It looked big, but the enthusiasm and determination of the "boosters' committee" was greater. The first announcement sent to the members early in December asked for the names of non-member engineers to whom invitations might be sent. A return of 25 per cent (300 names) was realized. In addition the names of the alumni of the technical schools were placed on the mailing list, giving 800 additional prospects.

The Personal Appeal

The next problem was to reach the membership as individuals instead of as a unit. This meant personal attention by letter, telephone, or interview, and represented an enormous amount of work if carried to completion. It was necessary therefore that this work be divided among a number of men who could be depended upon to do their parts thoroughly and on time. To this end each member of the "boosters' committee" and each officer of the society chose from the membership the men he would try to reach personally. Accordingly on Jan. 3, or thereabouts, at the time the second announcements were mailed, these boosters and officers sent out over 700 letters urging their fellow members to attend the events of the meeting.

As the time for the dinner drew near careful record was kept of the results brought in by these letters and three days before the dinner each man who had taken part in the work was notified of his percentage of acceptances and the names of those who had not responded as a result of his personal attention. This called for a second letter to the tardy ones, which doubled each man's percentage and in some cases increased it many times over, in the short space of 24 hr. Again on the eve of the dinner certain members of the committee worked far into the night sending notices to each booster with a last appeal for a special effort to make every member feel the necessity of his attendance. During the daylight hours the wires were hot carrying urgent telephone calls that would not take "no" for an answer. This ended the campaign of the boosters' committee and when the final count was taken in the banquet room of the Auditorium Hotel, 390 engineers were present.

Tables were reserved for the alumni of several technical schools, for groups from the railroad offices and the telephone company, and at one long table sat all the attending past-presidents. The festivities started with a series of college yells and songs. From that moment good fellowship reigned supreme. A "war extra" announcing the results of the annual election in scarehead type and parodied lyrics by James N. Hatch, relegated logarithms and blue prints to the evening's scrap heap. Douglas Malloch as toastmaster was at his best. A series of clever telegrams good-naturedly exposing characteristics of some of the prominent members brought forth laughter and applause at regular intervals.

Excursion and Smoker

Early the next morning the waiting rooms of the Dearborn Street Station held many engineers, all eager to purchase tickets and board the seven-coach Western Society Special for an all-day trip through the industrial district of Chicago. Immediately upon leaving the station a count was taken and given as 500 members and guests.

In the evening of the same day 325 members and guests assembled in the society rooms for the final event of the annual meeting. The committee made good its promise that the smoker should be a strictly informal good time. There was a can of tobacco, some corn-cob and briar pipes, and plenty of stogies to make it a real smoker. In one corner stood a big barrel of cider and alongside of it a table loaded with 8 big pans of old-fashioned ginger bread. After each one had secured a big piece of the ginger bread and something to smoke, the meeting was called to the lecture room, where the Armour Musical Club entertained with college songs and orchestra selections, George Frederick Wheeler gave an illustrated travel talk on the Panama-Pacific Exposition, the Grand Canyon, Yellowstone Park and the scenery en route.

National Forest Fires in the West caused a loss of $677,816 in 1914, according to a statement issued by the U. S. Forest Service. About 340,000,000 ft. b. m. of merchantable timber, valued at $307,303, were destroyed, together with young growth valued at $192,408, and 228,008,000 ft. b. m., valued at $175,302, of timber on State and private lands within the forests. The total area burned over was 690,240 acres, of which 310,583 acres were State and private lands. More than half of the fires, involving 85 per cent of the loss, were in Idaho, Montana, Oregon and Washington. Of the 6605 fires reports, lightning started 2032, campers set 1126 and railroad locomotives were blamed for 1110.

Literature

For the Civil Engineer and Contractor

New Publications

Federal Valuation of Railroad Property. By Richard J. McCarty. Paper; 5½ x 8½ in.; 103 pages. Kansas City, Mo., Tiernan-Dart Printing Company.

Engineering Directory, 1915 Edition. Two Volumes. Vol. I, leather, 4 x 7 in.; 893 pages. Vol. II, cloth, 8 x 11 in.; 468 pages. Chicago, Crawford Publishing Company, $6 postpaid.

Report on the Iron Canyon Project. By the U. S. Reclamation Service, Portland (Ore.) office. Paper; 6 x 9 in.; 147 pages; illustrated. Portland, Ore. U. S. Reclamation Service.

Proceedings of the Good Roads Institute held at the University of North Carolina March 17-19, 1914. Paper; 7 x 10 in.; 117 pages; illustrated. Raleigh, N. C., North Carolina Geological and Economic Survey.

Concrete Stone Manufacture. By Harvey Whipple, Managing Editor, Concrete-Cement Age. Leather, 4 x 7 in.; 255 pages; 126 illustrations. Detroit, Concrete-Cement Age Publishing Company. $1 post paid.

National Standard Hose Couplings and Fittings for Public Fire Hose. Bureau of Standards. Circular 50. Paper; 7 x 10 in.; 23 pages; illustrated. Washington, D. C., Superintendent of Documents. 10 cents.

Rapid Transit Railway and an Interurban Railway Terminal. Report with plans and estimate of cost for the city of Cincinnati. By F. B. Edwards and Ward Baldwin. Paper; 8½ x 11 in.; 87 and VII pages; illustrated.

Practical Irrigation and Pumping. By Burton P. Fleming, M.E., Head of Department of Mechanical Engineering, State University of Iowa. Cloth, 5 x 8 in.; 226 pages; 67 illustrations. New York, John Wiley & Sons, Inc. $2 net.

Heating and Ventilating Buildings. By Rolla C. Carpenter, M.S., C.E., M.M.E., LL.D., Professor of Experimental Engineering, Cornell University. Sixth edition. Cloth, 6 x 9 in.; 598 pages; 290 illustrations. New York, John Wiley & Sons, Inc. $3.50 net.

Revenues and Expenses of Steam Roads in the United States for December, 1914. Summary prepared by the Bureau of Railway Economics. Bulletin 72; 14 x 17 in.; four pages. Text, tables and diagrams. Washington, D. C., Bureau of Railway Economics.

Highway Bonds; a compilation of data and an analysis of economic features affecting construction and maintenance of highways financed by bond issues, and the theory of highway bond calculations. By Lawrence I. Hewes and James W. Glover. Paper; 6 x 9 in.; 136 pages; illustrated. Washington, D. C., Superintendent of Documents. 25 cents postpaid.

The American Year Book, 1914. A record of events and progress. Edited by Francis C. Wickware, B.A., B. Sc. Cloth; 5 x 8 in.; 862 pages. New York and London, D. Appleton and Company. $3 net.

This book contains chapters on engineering, mathematics, geology, chemistry, physics, mineral industries and other subjects of interest to engineers.

Books Reviewed

Structural Steel Drafting and Elementary Design

Author, Charles D. Conklin, Jr., C.E. Cloth, 9 x 12 in.; 154 pages; 151 figures. New York, John Wiley & Sons, Inc. $2.50 net.

Reviewed by R. Fleming

American Bridge Company, 30 Church Street, New York City

The object of this book, as stated in the publisher's announcement, is to give to the young draftsman in the structural steel companies, as well as to the technical student, a textbook from which he can obtain information upon the practical method of preparing shop detail drawings.

The book is divided into fourteen chapters. The first four treat of the organization of the drafting room, estimating and designing, lettering, assembling marks and ordering of material. A chapter each is given to riveted connections, beam and column detailing, and wall girder and column design and detail. These are followed by successive chapters on the design and detail of a steel roof, a deck plate-girder railroad bridge, a through girder bridge, a country highway bridge, a through riveted railway span and railway truss bridges. The closing chapter is on hip and valley details.

A merit of the book is that the author does not undertake too much. The design portion, though elementary, is complete enough to enable the draftsman to obtain a clear and concise knowledge of the stresses and moments in the structure which he may be detailing. The structures used for illustration are simple and typical. Such a presentation is far better for the beginner than that of more ambitious ones with their complicated details.

The figures, of which there are many, are clear and well drawn. In a few of them slight changes might be made to advantage. The rules for detailing are in accordance with the best practice and the information given is up to date. A page might profitably be added on points to be observed for facilitating erection. Every erector of steelwork who has been long in the business will recall details that have unnecessarily added hundreds of dollars to his expense account. Another page or two might be added on the importance of the draftman's work. When steel structures have failed it has generally been from faulty details rather than from lack of strength in the main members.

As a whole the book is excellent and well adapted to the purpose for which it has been written.

Theory of Foundation Piling

Teori för Grundpalninger. Author, Per Gulliander, Professor at the Chalmers University of Technology, Gothenburg, Sweden. Paper, 6 x 9 in.; 80 pages; 25 illustrations and one insert. Stockholm, P. A. Norstedt & Söners Förlag. 2.25 Kr. (60 cents) net.

The title of this little book, "Theory of Foundation Piling," gives its scope. The author has purposely avoided dealing with methods of determining the actual carrying capacity of piles, or indicating how much single piles may be expected to carry when driven into different kinds of soil. At the end of the book, however, is a table giving a log of tests on the carrying capacity of friction piles for buildings and harbor work in the city of Gothenburg, Sweden, where the soil consists generally of blue clay. The piles tested are from 30 to 75 ft. long, with a minimum diameter of from $3\frac{1}{2}$ to $7\frac{1}{2}$ in. The table gives the permissible loads on these piles to be from 1.7 to 9 tons, assuming a factor of safety of 3.5.

The purpose of the book is to furnish the designer with methods by means of which it can be determined how much of the total load on a foundation each pile will be called upon to carry. The theories are based on the assumption that each pile will be deformed to correspond with the amount of the load, and that such deformation consists of three elements—a horizontal deflection t, a vertical deformation S and a rotation δ. For certain conditions of loading one or more of these elements may equal zero. The different systems of pile foundations met with in practice have been classified under three general groups: (1) Foundation piling with the piles parallel with each other and with the resultant of the loading—the masonry assumed to be freely supported on the piling; (2) foundation piling with one plane of symmetry and the piles parallel with this plane, but otherwise driven in any direction—the masonry assumed to be freely supported on the piling; (3) foundation piling with one plane of symmetry and the piles parallel with this plane, but anchored or fixed in the masonry. To illustrate the practical application of his theories the author has solved numerical cases for each group.

As this book is the first complete treatise of foundation piling it is desirable that it be translated into English and made available for a larger number of engineers than those able to read Swedish. Several useful articles have appeared in German, French and Swedish periodicals, but so far very little has been made available for engineers able to read English only.

Valuation of Public Service Corporations, Part II

Author, Robert H. Whitten, Ph.D. Cloth, 6 x 9 in.; 645 pages. New York, Banks Law Publishing Company, $5.50.

This volume, as the title indicates, is essentially supplemental to the book produced by the author in the spring of 1912. Since then Congress has passed the valuation act and the Government work has been put in full swing, while the Minnesota rate decision, the presentation and spirited discussion of the first progress report of the special valuation committee of the American Society of Civil Engineers, and various other events have occurred which have changed the aspect of valuation matters and impelled the author to enlarge upon his first work.

The supplement follows the form of the original book, the page numbering being continuous and the chapters and headings being identical with those in the original volume, except that on a few of the thirty-two topics there is no further discussion and the chapters are omitted. The author also follows the form previously employed in that a large part of the new work is devoted to abstracts of court and commission decisions, and that on many of the points the author is non-committal, simply presenting in an uncolored manner the opinions of others. On several important questions, however, he gives his own views at some length, and in these it seems to the reviewer that the common error is committed of failing to differentiate between different classes of utilities. In general the reviewer believes the theories are more applicable to the monopolistic local utility, such as the waterworks company, than to the competitive large-territory class, such as the railroad.

Inasmuch as the volume consists so largely of these decisions, it might be inferred that the author, like a number of engineers who have discussed the subject in the last year, considers the various questions already answered by the courts. Such is not the case. At the outset he states that the very definition of fair value for rate purposes is in a developmental stage, and that "the determination of a standard of value applicable to existing investments will be worked out, if at all, by the slow and piecemeal process of court decision in numerous cases." He sees in the decisions of the last two years a trend away from reproduction cost and toward actual cost. He points out what seem to him inconsistencies in "reproduction cost under original conditions" and argues for actual cost as more nearly representing the ideal "cost of production." The reviewer has not perceived this judicial trend away from reproduction cost, and does not see how any other method can be applied to railroads.

The chapter on land leaves the reader in great doubt as to just how the author would deal with the so-called "unearned increment." He makes it clear that he regards this as profit, but does not explain fully how or to what extent he would make allowance therefor. As the author seems to be in disagreement with the trend of the courts to recognize without reservation the present market value, as indicated by excerpts from the Minnesota rate case and others in this same chapter, it is unfortunate that he did not make his theory clearer.

On the subject of depreciation the author presents the arguments offered by the valuation committee of the American Society of Civil Engineers a year ago. He holds that depreciation is a matter of accounting, and that whether or not it should be deducted depends on whether the straight line, sinking-fund or uniform-investment-charge (equal-annual-payment) method of figuring depreciation is used. The fourteen-page discussion merits careful reading by all interested in evaluating waterworks utilities or other properties made up of a few long-lived units. Railroad appraisers, who know that on a seasoned railroad of any size renewals are nothing more than a form of maintenance—operating expenses pure and simple—and that no depreciation fund is necessary or desirable, will not find these pages so instructive.

To one other point the reviewer must take exception. The author recognizes "going value" as something real, but would refund it by an excessive rate of return for a certain period, not allowing it as a permanent investment. In this he attributes to mankind an altruism that does not exist; it does not seem feasible to ask the present generation to pay more in order that all others may pay less.

However much the reader may disagree with the theories of the author, however, he will find the volume invaluable as a compilation of judicial opinions on every phase of the subject. Many minor points on which one is hazy will doubtless be clarified by a perusal of the book. An admirable 73-page index at the end covers both volumes.

Meters Eliminate Lawn Sprinkling Regulations in Columbus, Ohio, according to Jerry O'Shaughnessy in a paper presented recently, before the Indiana Sanitary and Water Supply Association. Columbus has no regulations but has 95 per cent of the taps metered. In 1890 with 7 per cent of the taps metered the daily consumption was 1021 gal. The corresponding figure for 1914 was 552 gal. In April rents were collected from 27,000 consumers, 13,300 of whom used no more water in six months than 3000 cu. ft. In October, 28,000 consumers were collected from, of whom 10,500 used no more than 3000 cu. ft., notwithstanding the inclusion of the sprinkling season. As to hours the rate recording charts show that the habits of the consumers regulate this—6 to 8 a. m. and 5 to 9 p. m., with maximum rate at 7 p. m.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Concrete Pavements After Twenty Years of Service

Sir: In 1893 and 1894 Bellefontaine, Ohio, constructed about 7300 sq. yd. of concrete pavement around the Public Square. A strip 10 ft. wide and 220 ft. long on the west side of Main Street was built in 1892. These were among the first if not the first concrete street pavements constructed. They were built in blocks 5 ft. square, having a thickness of 6 in. The bottom 4 in., to use the language of the specifications, was of "one part best Portland cement, equal to the Buckeye Portland cement, to four parts clean sharp gravel and sand in which the proportion of the sand is about one-half that of the gravel." The top 2 in. was composed of "equal parts of the same Portland cement first used and coarse sand and gravel sifted to the size of a pea."

Buckeye Portland cement, a local product, was used. Sand and gravel were obtained from local banks. The 5-ft. blocks were laid so that the joints between them were parallel and perpendicular to the center line of the streets.

In the light of twenty years' experience it is plain that a mistake was made in placing the blocks in this position. Had they been placed at an angle of 45 deg. with the center line it is the opinion of the writer that no repairs would have been necessary to this date. Under the existing conditions the cost for repairs in the last seven years has been $173.88. There is one year previous to this record in which extensive repairs were made but for which the writer has been unable to obtain any figures.

All repairs to date have been made along the longitudinal joints. By repairing some of these longitudinal joints which have worn badly these streets could be put in as good condition as the day they were opened to traffic. The body of the blocks with but one exception is in excellent condition. The only deleterious wear on the street has been along the longitudinal joints, and this after being subjected to the heaviest travel of a town of 8000 inhabitants for a period of more than twenty years. Present-day good construction would eliminate these longitudinal joints and at the same time the principal objection to this pavement.

Clair A. Inskeep,
Bellefontaine, Ohio. City Engineer.

To Compute Offsets to Circular Curves

Sir: I have read William A. Cunningham's comments in your issue of Feb. 20, page 244, on my method of computing offsets to circular curves, and have examined the solution he offers for this problem. As reference to my article will show, I laid special emphasis on the fact that the method presented was applicable equally to curves of both the largest and smallest radii, that is, to all ratios of R and x. Not so much can be said for the device Mr. Cunningham makes use of, a device which, incidentally, has been in use for a long time among computers.

For suppose that R is large, say 1350 ft., and x relatively small, say 10.387, then the expression $\sqrt{(R-x)\,(R+x)}$ will contain two numbers, each consisting of seven significant figures. Now even the most precise logarithmic tables in use do not give more than five significant figures in the number column, necessitating the interpolation of two significant figures. The accuracy of the expression is therefore not greatly to be relied upon in the hundredths or thousandths place. The resulting percentage of error in the term $\sqrt{(R-x)\,(R+x)}$ considered by itself is, of course, small, but since the quantity we are interested in is the difference between R and $\sqrt{(R-x)\,(R+x)}$ (a very small quantity relatively speaking), it is evident that a slight percentage of error in $\sqrt{(R-x)\,(R+x)}$ is a large percentage of the difference.

To state the case more generally: For purposes of computation, it is undesirable to have an expression for a relatively small quantity consist of the difference between two relatively large quantities, since a small percentage of error in either minuend or subtrahend is invariably a much larger percentage of their difference. The advantage of using a direct expression, such as I have presented, is then immediately apparent.

Leopold Pistner,
Junior Engineer, New York Public Service
Commission, First District.
New York City.

West Fork Waterworks Dam at Fort Worth

Sir: The article on the West Fork waterworks dam at Fort Worth, Texas, which appears in your issue of Jan. 30, page 147, was noted with interest, particularly the spillway section shown by Figs. 1 and 2, page 148.

There is not given sufficient information bearing on the character of the subfoundation to form an idea of the conditions to be met. Broadly speaking, however, it would seem that both the designs shown are subject to criticism as regards economy with an assured degree of stability.

The proposed section, Fig. 2, would probably have been the more economical and efficient design, assuming that local conditions warranted the rather extreme depth of trench shown under the heel and discarding the trench at the toe altogether. It is not clear whether the purpose of the latter trench was to prevent under-cutting of a poor quality of bedrock or the passage of water under the dam. If the former condition was to have been met, an apron entirely separate from the dam would have been cheaper and more effective; if the latter was in mind it may be safely stated that water which finds its way under the base of any dam should be allowed to escape as freely as possible and drains to facilitate that escape provided.

The section built (Fig. 1) has two obvious faults—extreme width of base and a cutoff wall at both heel and toe, the former multiplying and the latter intensifying under base pressure. It is apparent from a glance that this condition was met by making the body of the dam exceptionally heavy, it being, in effect, 20 ft. thick at the crest with a 1:1 slope on the downstream side. It would seem that the width of base might well have been decreased by at least 50 per cent and the weight of the body of the dam almost as much by supplying a proper system of under base drains and protection to the rock below the dam, if that were necessary, by a detached apron or, at any rate, a covering which need not be figured as an extension of the base of the dam proper.

H. G. MCCORMICK, C. E.
Heidelberg, Ky.

[A copy of the foregoing letter was submitted to John B. Hawley, who, with Prof. T. U. Taylor, designed the section shown in Fig. 2 of the article referred to. Mr. Hawley's reply follows.—EDITOR.]

SIR: The writer just read the letter addressed to you by H. G. McCormick anent the Fort Worth West Fork dam. Mr. McCormick's criticism is, in general, well founded, both designs being entirely too heavy—the one adopted absurdly so. Politics, and very rotten politics at that, was responsible for the adoption of the outrageous design over the protest of Taylor and Hawley.

However, the Taylor-Hawley section, while in excess of actual requirements, is not wholly extravagant, foundation material considered. The masonry section is located on a mass of alternating limestones and soft shales, and the heel and toe curtain walls are indicated for the maximum depths that might be necessary, as shown when the trenches should be actually opened. Neither Professor Taylor nor the writer anticipated that the maximum depth shown would be reached, but wished to show the possibility on the plan.

The section is thoroughly underdrained as against seep water which might have caused negative head.

On the rational analysis of the stress involved, even the Taylor-Hawley section is far too massive, but the character of foundation is such as to reasonably warrant it.

The design was based on raising the crest elevation by 5 ft. at some future time, and for a maximum depth of overflow of 8 ft. on the crest.

JOHN B. HAWLEY,
Consulting Engineer.
Fort Worth, Texas.

Will Pioneer Bore Weaken Rogers Pass Tunnel?

SIR: I read with interest the article bearing on the Rogers Pass tunnel, being driven through the Selkirk Mountains in British Columbia, described in the Engineering Record of Dec. 5, 1914, page 604. On account of the magnitude of this enterprise, and more especially the construction method adopted by the contractor, for the purpose of increasing speed in driving, it cannot fail to attract widely the attention of tunnel men. A deep knowledge of the problems involved in such a work is required to try a novel method on a large scale, and the engineering profession will undoubtedly gain valuable information through the completion of this bore.

The double-bore system of tunneling has attracted much attention among European engineers during the past decade, and much has been learned from the experience gained in driving the Simplon tunnel. When the latter project was considered, little information was available to guide the engineers as to the distance to provide center to center of bores, and 56 ft. was then considered adequate for the purpose intended. It was thought feasible to drive one bore first to full section and line with masonry, leaving the parallel 6 x 10-ft. heading unlined until conditions of traffic would necessitate its enlargement to a full-size single-track section.

Prof. Dr. Heim, the noted Swiss geologist, who has devoted much of his time studying mountain formation and especially ground pressure in connection with tunnel work, strongly recommended that the parallel heading be lined at the very outset. His recommendations, together with his theory of ground pressure acting on a bore in a "hydrostatic-like" manner, met with little appreciation from tunnel men, although the valuable experiments of Adams and Nicolson had proved that marble, for instance, could be made plastic under high pressure, and that test specimens had been made to undergo a change of shape without losing any of their original strength.

Heim's theory, which in many instances has proved to be well founded, can be briefly outlined as follows: "Under high pressure, rock in a mountain range or under a peak lies in a state of 'latent plasticity.' When, through the process of tunneling, rock is freed on one or more sides, it endeavors to expand, or acquire its original shape, that is, the shape and volume it occupied before becoming subjected to compression during the period of mountain formation; hence the phenomenon of 'shelling or popping' of rock, during construction of and after driving a bore such as a tunnel, shaft, etc. This expansion or change of volume takes place more or less slowly (a week or several years) according to the material penetrated, its cohesion, also the geological formation of the mountain, the heat prevailing, etc."

As referred to above, little consideration was given to Heim's theory by tunnel men; yet, during the construction of the Simplon tunnel, heavy ground pressure and shelling took place in apparently sound and hard rock, and it became necessary to line certain sections of the parallel heading at the very outset. As years passed, more shelling occurred in the roof, sides and floor of the parallel unlined heading, in certain instances partly choking it with débris, and it became evident that unless the parallel heading be lined at once with masonry, extensive damage would result, this possibly extending to the completed bore. This year, that is, about fourteen years after the completion of the latter bore, intense shelling took place in the parallel heading, and serious lateral movements of the masonry side walls took place in the completed bore; thus the mountain, far from having reached a state of rest, was still exerting its crushing effects.

Shelling of rock in an unlined tunnel means a slow but gradual enlargement of the section, and the larger a bore the more intense become the shelling and crushing effects. Shelling of rock usually takes place in solid rock; the phenomenon has taken place in granite, aplite, porphyry, granite-gneiss, diabase, sandstone, quartzite, limestone, dolomite, coal and shale.

In the Leggistein tunnel shelling took place in the roof several years after its completion; the effect would last for a month or two at a time. In the Wattinger tunnel violent shelling took place under the track. In the Tauern tunnel shelling took place at the roof, floor and sidewalls. Shelling has also been observed in the Wocheiner, St. Gothard, Pfaffensprung and many other tunnels penetrating all kinds of formation, but always in solid rock having a sound appearance.

The Rogers Pass and Simplon tunnels present striking resemblance as shown in the accompanying table. From the standpoint of stability the roof of Rogers Pass tunnel, being a double-track bore, is less stable than that of the single-track bore of the Simplon tunnel, and the thrust due to arch action is of course greatest in the first bore. Furthermore, both headings in the Rogers Pass tunnel are driven at the top, or roof, so that the shattering effects due to blasting are more injurious in the latter case. Another disadvantage lies in the fact that the masonry lining in the main bore is not built immediately, so that initial movements of the strata, however small these may be, are not checked at the very outset.

RESEMBLANCE OF ROGERS PASS TO SIMPLON TUNNEL

Name of tunnel	Maximum overlying depth, ft.	Dividing wall between bores or pillar, ft.	Maximum rock temperature, deg. Fahr.	Materials penetrated
Rogers Pass.	5000	31.5	*130	Sedimentary and metamorphic
Simplon	6000	30.5	115	Sedimentary and metamorphic

*Probable.

Thus, the question as to the necessity of lining the pioneer bore of the Rogers Pass tunnel becomes an item of vital importance which deserves due consideration from the standpoint of construction and maintenace of both the pioneer and main bores. The unanimous opinion of experienced tunnel engineers and that of geologists who have given this matter due consideration is that the distance center to center of bores of a twin tunnel system should be at least two or three times that adopted when driving the Simplon tunnel. Those who have devoted some time to this interesting question will undoubtedly watch with interest the behavior of the material penetrated by the Rogers Pass tunnel.

EUGENE LAUCHLI,
Civil and Hydraulic Engineer.
Tallulah Falls, Ga.

[Comment on the foregoing letter by representatives of both the railroad and the contractors, to whom copies of the letter were submitted, indicates the belief that the pioneer bore is too small to have any weakening effect on the main tunnel. If trouble is experienced it is suggested that the remedy will be to fill the pioneer bore, which is simply a convenience during construction, instead of lining it.—EDITOR.]

MECHANICAL FILTERS, according to the "Surveyor," have been adopted by the British War Office for the treatment of water supplied to soldiers in various camps.

HINTS FOR THE CONTRACTOR

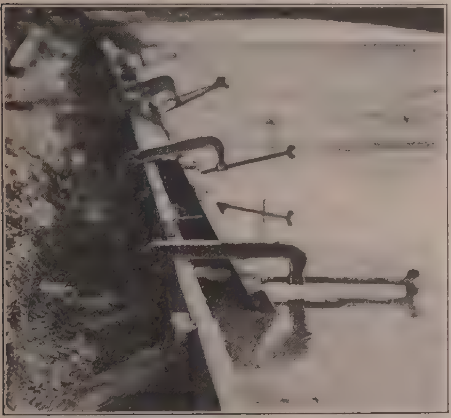
Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Carpenter Braces Hold Forms for Concrete Street Curbs

CARPENTER braces have been used effectively in the Middle West to clamp the forms used in the construction of integral curbs—a term used to designate curbs which are poured to form a monolithic structure with the street pavement proper. The pavement is first struck off in the usual manner, then a board is clamped in place to act as the inside form of the curb. This board is maintained at the desired angle by spacers placed between it and the outer form, which extends from the bottom of the pavement to the top of the curb. Reinforcement used in the pavement should be bent upward into the curb space, preferably near the inside face of the curb. The concrete at the bottom of the curb space should be roughened by the use of a rod or stick, and the concrete for the curb should be placed before the underlying concrete has begun to harden, all to the end that a perfect bond may result, and the pavement and curb be truly monolithic.



CARPENTER BRACES CLAMP CURB FORMS

Hints on Selecting Plant for Reinforced Concrete Buildings

SIMPLICITY and adaptability should be the main considerations in selecting plants for concrete building work. T. Arthur Smith, general superintendent of the Turner Construction Company, emphasized this point in introducing his paper on the Austin Nichols building, presented at the recent meeting of the American Concrete Institute, and abstracted elsewhere in this issue.

Economy in the sucessful erection of reinforced concrete buildings is dependent on the efficiency with which the materials entering into the construction are handled upon delivery at the building site. The comparatively small yardage of concrete in any one building operation does not justify an elaborate and costly installation of receiving and mixing machinery. Inasmuch as even a large building operation seldom requires the use of the concrete plant more than four or five months, it is essential that the erection and removal of this plant shall be performed easily, quickly and cheaply. Its cost must be divided among several contracts, and hence prompt transfer from one contract to another is of utmost importance.

In order that varying conditions on different buildings may be met, it is desirable that simple standards of plant layout be adopted. When a special installation is considered necessary it is desirable, before determining on a final layout, to reduce the installation to a cost per cubic yard of concrete. This very often shows that the saving in the handling of materials is not sufficient to offset the cost of this special installation. Also, in special layouts, the labor of erection and removal is unusually high, and the bulk of the cost of materials entering into this installation should be charged largely to this one contract, as, after using once it may be some time before a similar installation is required, and plant depreciates rapidly.

Careful study must be given to the layout of every plant to be sure that it will fulfil all requirements. It must handle the total concrete yardage, without overloading, in the time allowed by the speed schedules, and should have the capacity for so-called "big days"—days when conditions of the work call for maximum output.

Bulk Cement Handled Like Sand on Small Job

IN constructing concrete foundations for five additional steel-frame storage tanks at Minneapolis, the 1250 bbl. of cement used was handled in bulk like sand. The cement shed was made of corrugated iron with a tarpaulin roof. In unloading the cement, which was received in box cars by rail, this tarpaulin was thrown back and the cement shoveled directly into the shed. From the bin to the charging hopper of the mixer the cement was handled in wheelbarrows, in exactly the same manner as sand was handled. The cement was measured by shoveling it into a metal tub which was then dumped into the wheelbarrow.

MEASURING BULK CEMENT IN TUB

The average crew employed by the contractor consisted of sixteen men and one foreman. Concrete was placed at an average rate of 100 cu. yd. a day. The capacity of the ½-yd. mixing plant was considerably greater than this, but the excavation, and hence the concrete work, had to be done in small sections, because the surrounding soil was carrying a heavy load from twenty-two tanks already constructed and in use.

The steel storage tanks were 50 ft. in

FOUNDATIONS FOR STORAGE TANKS WHERE BULK CEMENT WAS USED diameter and 65 ft. high. The foundations under them were designed for a load of 3000 lb. per square foot. Besides these foundations, the tank floors were made of concrete, and a 6 x 7-ft. reinforced-concrete tunnel was put in beneath the tanks for conveying machinery.

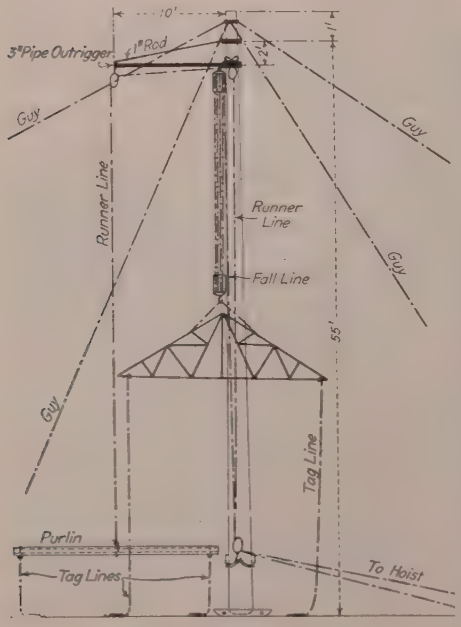
In addition to the ordinary economies, claimed for the use of bulk cement over sacked cement, the contractor adds that there is a distinct speeding up of operations, less confusion around the mixer, actually less dust in the handling, and elimination of loss through wetting sacks at the mixer. The contractor adds, however, that in its opinion the use of bulk cement on a larger contract would not pay.

This work was done for the Electric Steel Elevator Company by the Nelson-Enblom Construction Company of Minneapolis.

Outrigger on Gin-pole Saves Time in Erecting Roof Steel

By WILLIAM H. PALMER
New York City

An outrigger attached to the top of a gin-pole to handle purlins greatly reduced the time required for erecting the roof of a mill building on a Colorado contract of which the writer was in charge. This outrigger revolved around the pole and was made of a 10-ft. piece of 3-in. pipe guyed back to the gin-pole with a 1-in. rod. From the end of it was hung a snatch block through which the runner-line was rove. Before I took charge a gang of three men had been raising and connecting these purlins. One end of each purlin had been raised by a runner-line from a nigger-head of the hoist, which passed through a snatch block at the top of the gin-pole, and the other end had been raised with hand line by two men on the opposite roof truss. A man on the roof truss next the gin-pole and one of the men on the opposite truss carried each purlin down to place and bolted it up while the gang below waited for the lines to be released and sent back. The third man on top and the man on the nigger-head were idle all the time except while actually hoisting the purlins. After putting up the outrigger the runner-line was put on the top drum of the hoist, and the nigger-head man eliminated. Four men were then employed on top, two on each side, to set the purlins as follows: The runner-line was fastened to the middle of the purlin, and these members hoisted rapidly with the hoist. Two of the men on top swung it into position exactly where it was wanted and released the runner-line. While these two men were bolting up the purlin another one was being hoisted to the two men on the other side. In this way both of the crews bolting up, and the men handling steel on the ground, were kept busy continuously, with an estimated saving to the contractor of $317 a month on this part of the erection alone. The cost of the outrigger was $12.00.



OUTRIGGER HANDLES PURLINS

Home-Made Forge Valve Used at Steel Fabricating Plant

In an Eastern blacksmith shop connected with a field plant for fabricating steel a home-made forge valve was installed for each of the blower pipes, as shown in the accompanying photograph. The valve consists essentially of a 4¼ in. by 7 in. plate slide, 1/16 in. thick, fitting between two plates screwed into the cut ends of a 3-in. pipe, with narrow metal strips riveted through the fixed plates just above and below the slide, to keep the air from leaking when the latter is open. A simple hand lever provides easy control, and the placing of the valve below the bed of the forge keeps it well out of the way when handling projecting stock.

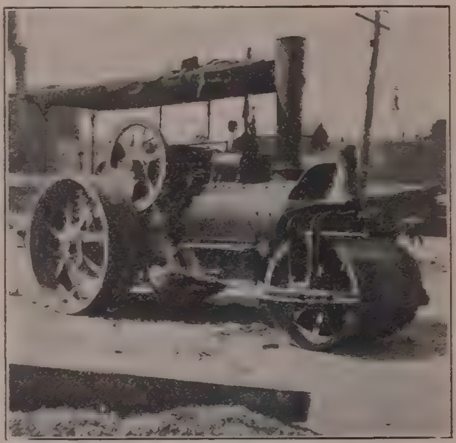
AIR VALVE FOR FORGE CONSISTS OF SLIDING PLATE ON 3-IN. PIPE

Closing Gaps in Joint Protection Plates in Concrete Roads

No matter how carefully the protection plates at transverse expansion joints in concrete roads are prepared, they are certain to gap open in places after the Tee-bar is stripped. It was suggested by C. D. Franks in his paper "Kinks in Road Construction," presented before the Indiana Engineering Society, which was abstracted in the Engineering Record of Feb. 13, page 197, that the workman run a light (16-gage) wire through the felt at points about 36 in. apart, passing one end of it through the holes left by the shear prongs, and the other over the top of the plates. These two ends can then be twisted up and will hold the plates closely together after the installation bar is stripped. They are on the surface of the pavement, but as they do no harm, can be left in place.

Welding of Heavy Broken Parts Saves Tying up 10-Ton Roller

The steam roller shown in the accompanying photograph collided with a wall, broke its main head-frame and swivel pin, and was repaired with oxyacetylene welding apparatus and returned to service with only one day's loss of time. The damage to the head frame casting and the 6-in. swivel pin is clearly shown in the second illustration, which makes plain what a heavy job of welding was necessary to restore these parts. As soon as the accident occurred the broken parts were removed from the roller and sent to the welding shop, where they were repaired in a few hours' time. To have secured new parts for this machine would have required at least a ten day's wait. The work was done with a Milburn welding outfit by the Alexander Milburn Company of Baltimore.



BROKEN FRONT CASTING ON THIS ROLLER REPAIRED AND REPLACED NEXT DAY

BROKEN PIN AND CASTING WELDED WITH TORCH

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Colonel Goethals and Other Canal Builders Honored by Congress

The House of Representatives, in concurrence with the Senate, authorized the promotion of Col. George W. Goethals to the rank of Major-General and extended the thanks of Congress in recognition of his services to the Government in the construction of the Panama Canal, in a bill sent to the President, March 2. Surgeon-General William C. Gorgas is also to be promoted to the rank of Major-General and receives the thanks of Congress. Col. H. F. Hodges and Lieut-Col. William L. Sibert are to be made Brigadier-Generals and are likewise thanked, as is Commander H. H. Rousseau, U. S. Navy, who is to be promoted to captain. These officers are declared to have "rendered distinguished service" and the bill provides that at any time hereafter any of them may be retired on three-fourths pay upon his own application.

Roosevelt Reservoir Nearly Full

In the expectation that the reservoir formed by the Roosevelt dam will soon be filled to capacity the Chamber of Commerce of Phoenix, Ariz., is making plans for a celebration to mark the event. It is the belief that if there is the usual Spring precipitation 1,000,000 acre-ft. of water will be backed up behind the huge dam.

Los Angeles Aqueduct Water Pure and Wholesome

Plaintiffs in the suit to restrain Los Angeles from using the aqueduct water have frequently cited, in the trial, the works of Dr. E. O. Jordan, professor of bacteriology in the University of Chicago, and have endeavored to show from his authoritative treatises on bacteriology that the aqueduct water was polluted and unfit for human consumption. Dr. Jordan happened to pass through Southern California recently and was asked by the city's lawyers to make a survey of aqueduct sources. He spent several days on the aqueduct watershed, and then testified that after a minute survey of the whole system, with special attention to the Haiwee reservoir, he found the supply to be pure and wholesome in every way.

Will Appeal Against Concrete Arch Decision

The city of Baltimore will appeal against the decision handed down by Judge Rose, of the District Court of the United States for the District of Maryland, as noted in these columns, Feb. 27, in which the court held that the use of steel reinforcement near the intrados and extrados of concrete arches is validly covered by patent 617,615 held by Edwin Thacher of New York.

Composite Cars Can Be Run on Strengthened Elevated Line

By reinforcing the Second Avenue elevated railroad in New York City at a cost of not more than $200,000, and transferring the cars to lighter trucks, the composite cars now in use in the subway can be operated on the elevated line, according to a report made to the New York Public Service Commission, First District, by Alfred Craven, chief engineer. Mr. Craven believes that the Third Avenue elevated line will be strong enough for the same operation after the third-tracking work is completed, but suggests that he have six months to complete his investigation.

Water Begins to Rise Behind the Arrowrock Dam

"Beginning to store water in reservoir today, two years ahead of schedule," is the laconic message wired from a canyon camp at the Arrowrock dam in Idaho to the U. S. Reclamation Service in Washington today.

It is a concise summing up of a little more than 3½ yr. of strenuous effort on the part of a thousand men in the construction of the highest dam in the world. The Arrowrock dam, which will be completed on Jan. 1, 1916, 2 yr. ahead of the original estimate, is 350 ft. high, 1075 ft. long on top and contains 530,000 cu. yd. of masonry. It is of rubble masonry, arched up stream and will cost approximately $5,000,000. The dam is an important feature of the Boise project, which represents an estimated total investment of nearly $14,000,000 for the reclamation of 243,000 acres of fertile land in the Boise valley in southeastern Idaho.

THE HIGHEST DAM IN THE WORLD AT ARROWROCK

Consolidate Engineering Offices

A bill to consolidate the offices of the State highway engineer and the State engineer was passed by the House of Representatives of the State of Oregon, Feb. 20.

Alien Labor Law Upheld by N. Y. Court of Appeals

Subway Work Disorganized—Appeal Taken to U. S. Supreme Court—Emergency Measure Introduced to Repeal Law

On Feb. 25 the Court of Appeals of New York State upheld the constitutionality of the provision of the labor law prohibiting the employment of aliens on public works, and forfeiting contracts in cases in which the law has been violated. The court took the position that the State has a right to say as between aliens and citizens who shall be employed and who shall receive the money spent by the State for the construction of public works. The court held that, while the law might be an economic mistake, it did not violate any provision of the State or Federal constitutions nor invade any private right. An appeal has been taken on the ground that this law violates provisions of the Federal constitution and of several foreign treaties. The Supreme Court will be asked to restrain the Public Service Commission and the sub-contractors from acting against the aliens pending the decision.

This suit was brought by William E. Heim, a taxpayer, to test the validity of the alien labor clause in the State labor law. In order to fully determine the question at issue a criminal proceeding was also instituted against Clarence A. Crane, secretary of the General Contractors' Association, who had a contract for the construction of a sewer catch-basin. The Appellate Division of the Supreme Court heard both these cases together on appeal and declared the law unconstitutional. This decision has now been reversed by the Court of Appeals.

Aliens Discharged

The first effect of this decision was to compel the Public Service Commission to notify the subway contractors in New York City that if they continued to employ alien labor their contracts would be voided. On Feb. 1 13,800 men were in the employ of subway contractors in New York City. Following the decision of the Court of Appeals the contractors promptly discharged all employees who could not produce evidence of citizenship. The contractors then went into the labor market and attempted to hire a sufficient number of American citizens to prosecute the work. By March 2 barely 6000 men had been mustered and put to work. So far as can be learned no one who could show that he was an American citizen and willing to work has been turned down, though many men employed have refused the task assigned to them and quit the job. The contractors have been obliged to discharge many others because of their manifested physical unfitness for the work. The class of men who have applied for work is well typified in the bread-line outside the 1-cent lunch in the City Hall Park. Most of them have no regular employment even in times of prosperity, and few of them have ever done steady manual labor. The attitude of these men toward their task is well typified by two cases in which the men applied for work on one contract after having been discharged from another. On being asked why they left the first contract they replied that the foreman put in charge of them had the impudence to give them orders, and they had thrown a pick at him.

Law Reacts on Unions

Not merely the unskilled pick and shovel workmen are affected by this decision. It is certain that a surprisingly large per cent of the union men employed on the subway are aliens, who have never taken out their final naturalization papers. Many of the bricklayers employed are Englishmen, and most of the shoring and timber crews are of foreign birth. The native born American applicants for the jobs of this latter class have had no experience in such work, and to entrust them with shoring a building or propping up a street would be to endanger public safety.

It has been suggested that the American-born industrial workers and mechanics who are out of employment in New York City at the present time and who are not attracted by the prevailing rate of wages of 20 cents an hour would flock to this work if the pay was raised to $2.50 or $3 per day. Even if wages for common labor are raised to this figure, though this would put the cost of completing the dual system beyond the reach of New York's finances, it is certain that these employees would not stick to the pick and shovel when conditions improved and they could return to their old jobs. When this occurs—and at least a partial improvement in industrial conditions is to be expected this year—there is no labor supply in sight to replace these workers which is not alien.

Seek Repeal of Law

Realizing the gravity of the situation, Governor Whitman announced on March 1 that he would send a special message to the Legislature urging the passage of a bill repealing the present law, and reaffirming the subway contracts which have been jeopardized through its violation. It seems likely that such a bill will be passed this week, but the question still remains whether the clause reaffirming subway contracts liable to cancellation through the contractors' having violated the old law would not be ex-post-facto legislation. In that event the letting of the remaining subway contracts, which has been held up pending the settlement of this matter, could proceed, but all contracts now in effect would still be jeopardized. Only the appeal to the U. S. Supreme Court can definitely settle this last question. If this court holds the alien labor law unconstitutional, the tangle will be definitely straightened out, and work can proceed. If a contrary decision is handed down, the outcome is problematical, but it is certain that in that event New York would have to wait a while longer for the completion of its new subways.

New Equipment for Structural Materials Research Laboratory

The material testing laboratory of the Lewis Institute, Chicago, has recently been reorganized and new equipment and apparatus have been added to it. Under the reorganization this department will be known as the structural materials research laboratory and the work will consist largely of experimental research on the strength and properties of construction materials, particularly concrete and concrete aggregate.

The present equipment consists of one 200-lb. Olsen universal testing machine; one 40,000-lb. Riehle universal testing machine; one 25,000-in.-lb. torsion machine; one four-unit Deval abrasion machine; one standard ball mill for macadam rock test; a special machine for drain tile tests; full equipment for physical tests of concrete; autoclave apparatus; a concrete mixer; a large number of metal forms of different sizes for cylindrical concrete compression specimens; a mechanical shaker for fineness tests of sands; equipment for the tests of weight, voids, silt, fineness and other properties of concrete sands and coarse aggregate; extensometers for measuring deformations in specimens; Micrometers, microscope, scales, analytical balances, recording thermometer and hydrometer, and the usual small equipment used in connection with the apparatus mentioned.

Laboratory quarters are in a large room on the ground floor of the Lewis Institute engineering building. At the present time a chemical laboratory is being equipped and this will be a valuable aid in making physical determinations on the properties of structural materials. As soon as the requirements of the work warrant, a testing machine of much higher capacity will be added to the present equipment. The Universal Portland Cement Company, is lending financial assistance in equipping and operating the laboratory.

Would Operate Self-Propelled Barges on the Mississippi

A company to operate self-propelled barges on the Mississippi River is being promoted by Capt. John H. Bernhard, consulting engineer, of New Orleans. Captain Bernhard has made a proposition to the city of St. Paul to build a terminal and deed it over to the city in exchange for municipal bonds covering the cost, the barge-operating company in turn to pay a rental sufficient to meet the interest on the bonds and retire them at the end of twenty years.

Captain Bernhard holds that his type of shallow-draft twin-screw barge, which has been in successful operation for some time on the coastal waterways along the Gulf of Mexico, is the logical craft for river navigation, and that it can easily compete with the railroad. In support of his contention he described at the recent Rivers and Harbors Congress a trip made by a 1000-ton barge from New Orleans to St. Paul and return. The 3842 mi. were accomplished in fifty-four days and eight hours, including time of loading and unloading. A total of 1182 tons were handled, the gross receipts being $2762.57, or 2.21 mills per ton-mile. By rail Captain Bernhard stated that the charges would have been $4932.98.

Engineering Work of Department of Agriculture Consolidated

The act making appropriations for the Department of Agriculture just passed by both houses of Congress, which was commented on editorially in the Engineering Record on Jan. 16, combines all of the engineering functions of the department under one bureau to be known as the Office of Public Roads and Rural Engineering. Among the principal detailed appropriations is one of $42,600 for inquiries in regard to systems of road management throughout the United States. For investigating the best methods of road making, especially ordinary sand-clay and dirt roads, $145,000 will be spent. An appropriation of $34,820 is made for investigating the chemical and physical characteristics of road materials, while for conducting field experiments on various methods of road construction and maintenance $60,000 is provided. Further appropriations of $106,400 are provided for investigating and reporting upon the utilization of water in farm irrigation; of $96,280 for investigating and reporting upon farm drainage and upon the drainage of swamp and other wet lands available for agricultural purposes; and of $12,805 for investigating farm water supply and drainage disposal problems. The total appropriation made for the office is $686,465.

Errors in 1914 Year Book of American Society for Testing Materials

In circular 94 the American Society for Testing Materials calls attention to the following typographical errors in its 1914 Year Book. Page 107, second line from bottom, last figure: For "3" read "30." Page 41, second line from bottom: Transpose the clause, "except as specified in Paragraphs (*b*), (*c*) and (*d*)" to follow the word "bars" on page 43, line 1.

New Bridges to Be Built in Chicago

Several new bridges are to be erected in Chicago, according to the latest report of the board of local improvements outlining the bridge situation. The Jackson Boulevard bridge, now out of service, will be complete in August. The Lake and Webster Street bridges will be out of service the entire year. The California Avenue bridge over the west fork of the south branch of the Chicago River will be completed in July, and the temporary bridge at Montrose Avenue will be replaced with a permanent structure in September. The temporary Belmont Avenue bridge will be replaced next year.

American Society Passes Amendment to Constitution

At the regular bi-weekly meeting of the American Society of Civil Engineers at the society house in New York City, March 3, the letter ballot on the amendment to the constitution was canvassed with a result overwhelmingly in favor of the new amendment—1155 ayes to 83 noes. This amendment increases the number of geographical districts from seven to thirteen. The illustrated paper on "Cinder Concrete Floor Construction" written by Harold Perrine and George F. Strehan, was presented by Mr. Strehan and discussed at length by G. B. Waite, author of the paper on "Cinder Concrete Floors" in Vol. 77 of the "Transactions" of the society. Others contributed to the discussion.

Receivers Appointed for Western Pacific Railway

Warren Olney, Jr., chief counsel of the Western Pacific Railway, and Frank G. Drum, of San Francisco, were appointed receivers of the railroad March 3. The company had defaulted the interest on a $50,000,000 bond issue.

Strength of Concrete Forms Discussed by Harrison S. Taft

It was Harrison S. Taft who added a valuable contribution to the data on strength of concrete forms at the eleventh annual convention of the American Concrete Institute, held in Chicago, Feb. 9, 10, 11 and 12, and not Harrison S. Fish, as erroneously announced in the Engineering Record of Feb. 20, page 248.

Illinois Section of American Waterworks Plans Meeting Next Week

The Illinois Section of the American Waterworks Association will hold its seventh annual meeting at Urbana, Ill., March 9 and 10. A large variety of papers on subjects of interest to the waterworks man have been prepared. The following are some of the papers to be presented: "Choice of Alloys in Connection with Waterworks Equipment," by Horace Carpenter, of the Sanitary District, Chicago; "Relation Between Bacteriological Standards and Vital Statistics at Hannibal, Mo." by W. F. Monfort, St. Louis: "Some Features of the Ontario Statutes and their Administration Affecting Water Supply and Sewerage," by F. A. Dallyn, provincial sanitary engineer, Toronto; and "Water Waste Prevention by Individual Meter versus District Meters," by R. O. Wynne-Roberts, Regina, Canada.

Boston Engineers Hold Annual Dinner

The sixth annual dinner of engineers affiliated with the various branches of the profession at Boston, Mass., was held at the Boston City Club on Feb. 15, this being the opening day of the new building of the club on Somerset Street. James W. Rollins, of Boston, was toastmaster, and the speakers were Harrison P. Eddy, president of the Boston Society of Civil Engineers; Charles Whiting Baker, editor of "Engineering News"; Capt. Robert A. Bartlett, of the Peary Polar Expedition; Charles H. Eglee, of Boston, and Governor David I. Walsh, of Massachusetts. Two hundred and sixty-seven were present.

Gov. Walsh, in Special Message, Urges Action on Boston Drydock

A special message has been sent by Governor Walsh to the Massachusetts Legislature urging action that will make possible the completion of the Boston drydock. The Governor points out that however opinions may differ as to the desirability of building the structure under different conditions, the fact remains that one-eighth of the total cost has already been spent, and only the weightiest circumstances could now justify the abandonment of the project. He thinks that the present state of suspense should be ended as soon as possible, and that if the Legislature hesitates to decide for itself so far-reaching a problem it should authorize the Directors of the Port of Boston to take action.

He also recommends that in the event of the Legislature approving the building of the drydock Congress be memorialized for an annual appropriation in aid of its maintenance.

Use of Panama Canal Estimated to Have Saved $1188 on One Trip

The steamship "Penrith Castle," which passed through the Panama Canal, Feb. 10, on a trip from Seattle to Liverpool, is estimated to have saved 23 days at sea by using the Panama Canal, which, figured at $230 per day and deducting for canal expenses and tolls, leaves a net saving of $1188. This same steamer passed through the canal once before on a trip from Galveston to Yokahama with a cargo of cotton, which was the first shipload of that commodity to pass through the canal.

Wooden Shingles Condemned by Massachusetts Commissioner

The committee appointed to consider the matter of combustible roof coverings at Boston, Mass., has reported to the metropolitan fire prevention commissioner, John A. O'Keefe, recommending that every municipality in the district pass an ordinance requiring the use of fireproof coverings on all roofs and dormer window tops. Commissioner O'Keefe will communicate this recommendation to every city and town in the district. The finding of the committee, which included a number of representative fire-insurance men and architects, is the outcome of an extended investigation of the relation of wooden shingles to the conflagration hazard, including a public hearing at which the features of fire-resistant roof coverings in comparison with wooden shingles were discussed at length.

Idaho Engineers Would Continue Stream Surveys

The Idaho Society of Engineers recently held a session with the House Irrigation Committee at Boise to urge the passage of the appropriation of $10,000 a year to continue the flow measurement of streams of the State. This work has been going on for five years in conjunction with the U. S. Geological Survey under funds appropriated by the Carey Act. These funds are now exhausted and direct appropriation is necessary for the continuation of the work. The society represented to the committee that unless the work was continued the data already secured would be valueless, that future irrigation progress would be retarded, and that the continuation of the work was essential for the protection of the present settlers on irrigated lands.

Boston Port Directors May Operate Their Own Dredges

The Directors of the Port of Boston are likely, it is said, to operate their own dredges in Boston Harbor by day labor if the current contract prices for dredging continue. The directors believe they are paying nearly double what they should for this work.

Lumbermen Plan Educational Campaign

As the result of a two-day lumbermen's mass meeting held in Chicago, Feb. 24 and 25, a national bureau was created whose duties will be to represent all branches of the lumber trade and allied interests. One million dollars, to be raised and spent at the rate of $200,000 a year for five years and administered by a body having headquarters in Chicago, will be used to promote the use of lumber in the United States. The new organization will start work as soon as $50,000 has been subscribed. The financial outlook is bright, however, inasmuch as the new project is backed by the leaders in the lumber industry.

The plan provides for the creation of a "department of trade extension" within the National Lumber Manufacturers' Association, which will be administered by an advisory committee composed of one wholesaler, one retailer, one timber land owner and two manufacturers. The new organization will effect the centralization of the promotional and educational efforts of the lumber trade.

The initial field of activity will be: Compilation of fire losses, insurance rates, building codes, uses of woods, substitutes for wood and anti-wood legislation; co-operation with other organizations of woodworking and consuming interests; teaching of uses for wood through speakers, bulletins, newspapers and magazine articles, exhibits, technical investigations of wood as construction material; development and extension of practical fire prevention methods.

Will Appoint Officials

Officials of the new department of trade extension will be named in the near future by the executive committee of the Forest Products Federation, a temporary organization which issued the call for the mass meetings. This committee includes R. H. Downman, of New Orleans, president of the National Lumber Manufacturers' Association; Gordon C. Edwards of Ottawa, Canada, president of the National Wholesale Lumber Dealers' Association; L. W. Crow, ex-president of the Lumbermens' Association of Chicago, and Julius Seidel of St. Louis. R. S. Kellogg is treasurer of the federation and E. A. Sterling secretary.

Financial Plans

It was pointed out at the meeting that the collection of the educational fund would mean a levy of only 1 2-3 cents per 1000 ft. on the output of the National Lumber Manufacturers' Association. Frederick Weyerhaueser of St. Paul is on the committee which urged the organization of a permanent body.

James Kirby, secretary of the United Brotherhood of Carpenters and Joiners of America, pledged the support of 250,000 members of his organization in the promotion of the use of wood products in construction work.

The Morena Dam—A Correction

Inadvertently the Morena dam was given as one of those designed and built by Hiram N. Savage, in the personal note relative to Mr. Savage's engineering activities in the Engineering Record of Feb. 20, page 251. While it is not desired to detract from Mr. Savage's achievements, it is well known that M. M. O'Shaughnessy, city engineer of San Francisco, was the builder of the dam in question.

War Takes Large Toll of German Sanitary Engineers

Information has come to former members of the staff of the German Emscher Genossenschaft now residing in the United States that nine members of the technical corps have been killed since the opening of the war. No news has been received regarding Dr. Imhoff since he was reported safe some months ago.

Indiana Engineers Assail Interstate Water Standards

Intended Primarily for Railroads and Steamships, the New Limits of Impurity Indirectly Affect Municipal Water Supplies

Serious objection to the high standards of purity of water required of the interstate carriers by the Federal Government was made at the meeting of the Indiana Sanitary and Water Supply Association in Indianapolis Feb. 23 and 24. H. E. Jordan led the discussion. While the standards for water were not intended to pertain to city supplies, Mr. Jordan said, the operation of the rules requires that such supplies conform to the new limits of impurity. Further, the assumption of non-multiplication of B. coli is not beyond dispute and public water supplies are being safely used which do not continuously conform to the qualifications.

Earle B. Phelps, professor of chemistry of the U. S. Public Health Service, argued that the railroads were not objecting and that the requirements were easily met by them and were not prohibitive as to expense, as the railroads had a choice of many sources from which to take water. Many ozone, hypochlorite and even ultra-violet ray plants were being installed. The comparative quantities which are required are so small that the expense of absolute sterilization is not at all burdensome. As to the reasonableness of the standards the cities know the history of a particular supply but the Government knows only the laboratory findings, and he felt therefore the standards should be high.

In further discussion it was held that city councils had long been waiting for a standard. It is practically impossible to convince laymen that the standard is not intended for city supplies and, as a consequence, the costs for coagulants and sterilizers has increased materially. In some instances it has been impossible to apply enough chlorine to do the work without causing serious tastes and odors. Whenever the Government asks the railroads about the water they are using they immediately send requests to the waterworks officials of the cities from which supplies are drawn so the matter of a standard comes to the water purveyors quickly.

The four sessions of the meeting were each well attended by the 200 persons who were registered. Of the eighteen papers and committee reports, twelve related to waterworks subjects specifically.

Technical Papers

A paper by Paul Lanham described methods of carrying on water waste investigations in Washington, D. C., and the means by which the division returns 57 per cent on the $32,000 investment cost per year in eliminating waste.

C. H. Hurd pointed out some of the difficulties encountered by the Public Utility Commission in arranging the forms for uniform accounts and putting them into operation. This was in the report of the committee on waterworks management and accounts. He believes better valuations can be made if the appraisers forget the purpose of the appraisal, whether for rate-making or for sale. Also the terms "depreciation" and "going value" both need new names more explanatory in character.

Wells and Cesspools

Vincennes has 3899 residences, 3000 wells, 187 cesspools and 3229 outhouses. It is built on a water-bearing gravel often used in common for waste disposal and water supply. The State Board of Health made an intimate sanitary survey of the city last year and found, according to a paper by John A. Diggs, that 24.9 per cent of the 3000 wells examined were contaminated. Vincennes has a good water supply and a good sewerage system, but no mandatory ordinances relating to connections. The Board of Health chemists found that the education of the people in the house-to-house canvass made was sufficient in most cases to convince the occupants of the desirability of abandoning their polluted wells.

In discussing Langdon Pearse's illustrated paper on "Treatment of Industrial Wastes," H. B. Hommon described the experimental work being carried on at Noblesville by the U. S. Public Health Service to determine a means of handling strawboard wastes. Sedimentation, mechanical filtration and chemical precipitation so far are not found practicable. It is required that enough values be obtained from the wastes to pay interest on the investment of any proposed treatment or recovery plant, otherwise the mill may be forced out of business.

Engineers at the convention were somewhat abashed at the rather boastful statements of Thomas Duncan, chairman of the Indiana Public Utility Commission, to the effect that, with one exception, the engineering force was made of men who received less than $1800 per year. A fitting pronouncement seemed then to follow when he remarked that with one exception, every public utility in the State had appealed from the commission's decision to reduce rates. After the speech the judge did not wait for the engineers to question him as to the reasonableness of the State in fixing salaries of its technical advisers at such a ridiculously low figure. There is less complaint, he said, of the inadequacy of the service given by the water companies than of the service furnished by most of the other utilities.

There is a move to legislate the Board of Health out of existence in Indiana. The association voted an endorsement of the board's work and an appreciation of Dr. J. N. Hurty's part in it, electing him as the new president of the association. The other new officers are: Vice-presidents, H. O. Garman, H. E. Barnard, R. L. Sackett, W. H. Durbin and E. C. Elliott; secretary, W. F. King, and assistant secretary, W. G. Ulrich.

City and College Unite in Study of Cracks in Pavements

To determine the causes of longitudinal cracking in brick and stone block pavements the Case School of Applied Science and the engineering department of the city of Cleveland will co-operate on a series of tests of moisture and frost action. From Maurice B. Greenough, instructor in highway engineering at the Case School, who planned the experimental work, the following information has been received:

The plans have been passed upon by Robert Hoffman, city engineer. Two streets will be under observation, one surfaced with stone block on a concrete base with sandy subgrade, and the other brick on concrete base in clay and shale, having considerable water present. About 1200 ft. on each street will be under observation. The grades in both cases are nearly flat.

The series divides itself into three general groups: (1) Preliminary observations and traffic census; (2) construction and observation; (3) Supplementary laboratory tests.

Group 1 will involve a traffic census and test borings. The traffic census will be very complete on both streets in their present condition; traffic counts will be continued at least three times a year. The test borings, cased and capped and deep enough to reach ground water, will be made at the curbs at intervals of 50 to 75 ft. Soil samples from each boring will be preserved for laboratory tests. Through these borings the level of the ground water will be measured to determine seasonal changes in elevation as well as that immediately after severe storms. Other soil samples will be taken from the center and sides of the finished subgrade for laboratory investigation.

Construction of the stone block pavement will be according to the specifications of the city of Cleveland. The brick paved street will be constructed in three sections: the first, 4-in. block on 1½-in. sand cushion, hard filler; the second, 5-in. block on ½-in. mortar cushion, hard filler; the third, 5-in. block on ½-in. asphaltic cushion, hard filler.

Small traps through the surfacing and base at the center and sides of the street, probably about 5 in. square, will be installed through which may be measured the depth of frost. They will also offer opportunity to study the expansion of the subgrade due to freezing. These will be spaced about 150 ft. apart if the subgrade is fairly uniform. Otherwise they will be nearer to each other. Other small protected openings, capped and made water tight, will extend through the surfacing only. These will be placed at the center and sides of the street also. Directly under them there will be imbedded in the concrete base a small metal plate to serve as a fixed point in the base from which may be measured the lift of the surfacing, if any, from the base, due to expansion as a thermal or other effect.

There will also be an attempt to duplicate the tests made by Mr. Howard on Cleveland pavements in 1912 as far as the movements of the surfacing is concerned. The laboratory tests will demonstrate, if possible, the amount and intensity of the expansive action of a known mass of soil, at a known saturation, under ideal laboratory conditions.

Active construction will begin about June 1. Case students in highway engineering will act as inspectors during construction. Records of observations and traffic censuses will be kept as a part of the work in that course.

State Must Defray Cost of County Road Condemnation

An important decision was handed down Feb. 5 by the Delaware County Court, New Jersey, affecting the condemnation cost of toll roads as being a matter for State consideration. In a hearing of the cases of the Doylestown, the Doylestown & Danborough and the Danborough & Plumsteadville Turnpike Companies, which brought a joint claim for damages of $30,000 against Bucks County for the abolishment of their roads, the court sustains a contention made by the county attorney that a county cannot be called upon to pay damages in connection with the condemnation of a road, and holds that although the county may have condemned the road, damages are recoverable from and payable by the State.

This ruling, establishing a precedent, opens the way for counties of the State to condemn toll roads and place the responsibility for damages directly upon the State. Under the court's decision all present toll turnpikes leading from Philadelphia into New Jersey by way of Delaware, Chester and Montgomery counties can be freed without expense to these counties, provided that they are part of the State's system of highways.

Col. Goethals to Write First Chapter of Engineering Congress Transactions

The scope of the first volume of the "Transactions" of the International Engineering Congress to be held at San Francisco, Sept. 20-25 has been outlined by the committee of management. It will comprise a series of papers on the engineering of the Panama Canal. The various topics and subdivisions of the work have been arranged by Colonel Goethals. Colonel Goethals has also selected the author for the treatment of each paper, and he will himself contribute the introductory chapter. The various authors are in general the officers who were in direct charge of the actual work of construction, and the collection of papers thus becomes a first-hand account of the engineering of the Panama Canal, written by the men who were in immediate and responsible charge of the undertaking.

There will be twenty-four papers in all, profusely illustrated, twenty-two of which deal with actual constructive and engineering problems connected with the work, one with the preliminary work in municipal engineering in the Canal Zone, and one with the commercial and trade aspects of the Canal.

The transactions of the Congress as a whole will include from seven to nine other volumes, covering all important phases of engineering work. Membership in the Congress with the privilege of purchasing any or all of the volumes of the proceedings is open to all interested in engineering work. For full particulars apply to W. A. Cattell, secretary, 417 Foxcroft Building, San Francisco, Cal.

News of Engineering Societies

The Technology Clubs Associated held a dinner at Pittsburgh Feb. 20.

The Engineers' Club of Baltimore held its annual banquet at the Hotel Emerson, Baltimore, Feb. 27.

The Louisiana Engineering Society will hear Major F. M. Kerr on "Forty-four Years with the Levees in Louisiana, 1871-1914," at its next regular meeting, March 8.

The Civil Engineering Society of Polytechnic Institute held a meeting in Brooklyn Feb. 19. George W. Tillson, consulting engineer to the president of the Borough of Brooklyn, spoke on "Street Pavements."

The Engineers' Society of Western Pennsylvania will hold a meeting in Pittsburgh March 16. William H. Burr, professor of civil engineering, Columbia University, will speak on "The Relation of Educational Training to Engineering Practice."

The Louisiana Engineering Society elected the following officers at its annual meeting: L. C. Datz, president; Samuel Young, vice-president; E. Hunter Coleman, treasurer; W. T. Hogg, secretary, and Ole K. Olsen to serve as director for three years.

The Brooklyn Engineers' Club on March 4 heard a paper on "The Lithotex Process; Improved Mechanical Methods in Lithography and Textile Printing," illustrated by lantern slides, by L. V. R. Holst, M.E., of the Lithotex Corporation, of New York City.

The American Society of Mechanical Engineers, at its meeting in New York, March 9, will hear a paper by Dr. Hollis Godfrey, president of Drexel Institute and consulting engineer, on "The Application of Engineering Methods to the Problems of the Executive, Director and Trustee."

The Minnesota Society of Engineers and Surveyors heard Prof. C. F. Shoop, of the experimental engineering department of the college of engineering of the University of Minnesota, read a paper on "The Abrasion Value of Various Concrete Aggregates in Concrete Roads," at the annual convention held at St. Paul.

The Utah Society of Engineers will hold a meeting in Salt Lake City March 19. N. A. Lockwood, consulting engineer of the Amalgamated Sugar Company, Ogden, Utah, will speak on "The Manufacture of Beet Sugar." The society has started the publication of a journal. The first number appeared in January as a sixteen-page, 6 x 9-in. book.

The Western Society of Engineers heard Prof. Daniel W. Mead on "Results of Twenty Centuries of Practical Engineering in China," illustrated by lantern slides, at a meeting held in Chicago March 1. Professor Mead recently returned from China, where as a member of the board of engineers on the Huai River conservancy project, undertaken by the American National Red Cross in the spring of 1914, he was afforded an unusual opportunity of studying conditions in the country of which he spoke. At the next meeting of this society, March 8, Prof. Albert Smith will speak on "Wind Stresses in Office Buildings."

The Seattle Association of Members of the American Society of Civil Engineers held its regular monthly meeting Feb. 22. Richard Khuen, resident engineer of the American Bridge Company, spoke informally on engineering and technical matters in the East. The principal subject of discussion was the report of the conference of presidents of local associations, which was held Jan. 19. John L.

Hall explained the report of the conference and told of many of the arguments leading up to the final report as adopted.

The American Society for Testing Materials will hold its eighteenth annual meeting at Atlantic City, N. J., June 22-26. Headquarters will be at the new Hotel Traymore. The executive committee desires to make recommendations in its next annual report upon the question as to whether the present policy of the society, by which the adoption of standards is determined by letter ballot of the society at large, shall be continued or abrogated. To this end a straw vote by letter ballot will be taken to ascertain the sentiment of the members in regard to this important question.

Personal Notes

W. A. Calderhead, of Palisade, was appointed county surveyor of the newly created Teton County, Idaho.

George A. Ricker, first deputy highway commissioner of the State of New York, has resigned. He was appointed to his office June, 1913.

W. R. Patterson has resigned from the office of assistant commissioner of public works of the Borough of Manhattan, New York City.

A. A. Woods, resident engineer of the New Orleans & Northeastern Railroad, at New Orleans, has been appointed superintendent, succeeding S. E. Flanagan, deceased.

J. T. Fieldseth, of Chicago, and D. R. Cather, of Portland, Ore., have been appointed junior engineers in the U. S. Reclamation Service, with headquarters at Provo, Utah.

W. H. Berry, of the engineering firm of Berry & Roberts, Chicago, has been retained as consulting engineer on the Grand Trunk Railroad's extension to Providence, R. I.

C. F. Kettering, vice-president of the Dayton Engineering Laboratories Company, delivered a lecture on "Cultivating the Engineering Sense" at the Ohio State University, Columbus, Feb. 26.

Fred W. Sarr has been appointed second deputy commissioner of highways of the State of New York. Mr. Sarr was once a division engineer in the State department to which he has been appointed.

H. F. Harris is named as one of the incorporators of the Detroit Engineering and Construction Company, Camden, N. J., formed for the purpose of engaging in an engineering and construction business.

Paul A. Hartung was appointed chief deputy in the county surveyor's office of Jackson County, Missouri, by Allen A. Southern, county surveyor, and his appointment was approved by the county court in Kansas City, Feb. 24.

Butler Smith has been appointed county surveyor of Grant County, South Dakota. His appointment is for 2 yr., and during this period he will probably be called upon to superintend the construction of a $100,000 court house.

C. M. Rogers, civil engineer, will superintend the construction of the Seabreeze (Fla.) water system. At a recent meeting of the Seabreeze council Mr. Rogers offered to assume the office on a 5-per cent basis and his offer was accepted.

William N. Collier, who has been stationed in Boston representing the Government in the construction of a new Custom House, has been appointed a supervising superintendent of construction of public buildings with headquarters at Kansas City, Missouri.

F. S. Burroughs, formerly chief engineer of the State Public Service Commission of Washington, has become connected with the Campion, McClellan Company, of New York City. At present he is in charge of construction work for this firm in the West.

H. Ellinge Breed was appointed first deputy commissioner of the State Highway Department of New York. Mr. Breed was formerly terminal engineer of the State Barge Canal and previously was many years in the service of the State department to which he has been appointed.

H. D. Shaw, former chief engineer of Gulfport, Miss., has opened an office in Gulfport for the purpose of engaging in a general engineering practice, specializing in municipal work. He was chief engineer for Gulfport for a period covering very nearly 7 yr., having quit railroad work to accept the office in 1908.

James F. B. Bowles, formerly physiologist in charge of water supplies and purification plants at Panama and recently sanitary expert with the U. S. Expeditionary Forces at Vera Cruz, Mexico, is now associated with the Lederle Laboratories, consulting experts in applied chemistry, bacteriology and sanitary science in New York City.

L. C. Datz, recently elected president of the Louisiana Engineering Society, is a member of the engineering staff in the New Orleans office of the United Gas & Electric Engineering Corporation. Formerly he was engaged in railroad work and was one time connected with the engineering firm of Ford, Bacon & Davis, in their New Orleans office.

P. A. Gibbons will succeed C. O. Vandevanter, who, as noted in these columns, Feb. 27, resigned as assistant engineer in charge of maintenance of streets in the city engineer's department of Baltimore. Mr. Gibbons has been connected with the city engineer's department for several years, having been a district engineer in charge of repairs to streets.

Joseph M. Prior has been appointed acting chief engineer of the Public Utilities Commission of Illinois, Springfield, succeeding Robert M. Feustal whose resignation was recently noted in these columns. Mr. Prior was formerly assistant chief engineer of the Illinois commission, coming to the commission from the engineering staff of the Chicago, Milwaukee & St. Paul Railroad, at Chicago.

Gustav J. Requardt has been appointed acting division engineer, in charge of the disposal division, by the Baltimore Sewerage Commission. He takes the place of H. C. McRae, recently resigned. Mr. Requardt has been connected with the sewerage commission since 1909 and had much to do with the design and construction of the disposal plant which he now has in charge. He will also have some construction work to look after, including the completion of twenty-eight Imhoff tanks.

J. P. J. Williams, recently assistant professor of structural engineering in the University of Minnesota, has joined the staff of the Engineering Record as associate editor. Mr. Williams was graduated from the University of Pennsylvania in 1898, subsequently receiving the degree of master of science (1899) and civil engineer (1908) from the same institution. For two years he served there as instructor in drafting, descriptive geometry and stereotomy and then was instructor in civil engineering at Swarthmore College. The two years, 1902-04, were spent as draftsman for the Pennsylvania Steel Company and the Southern Pacific Company, followed by two years as instructor, giving courses in strength of materials and stress analyses, at the University of California. The autumn of 1906 found him again in the East, with the Baltimore Bridge Company. In 1908 he became assistant engineer and designer with the McClintic-Marshall Construction Company, leaving there in the summer of 1910 to accept an appointment as assistant professor of civil engineering at Columbia University, teaching strength of materials, masonry and reinforced-concrete construction and bridge design. He continued in this work for three years and was then appointed assistant professor of structural engineering at the University of Minnesota. Since the close of the school year of 1913-14 he has been engaged in private work. Mr. Williams has contributed in recent years to the discussions of the American Society of Civil Engineers (of which he is an associate member), and is the author of several important structural articles published in Engineering News. He has in hand at present a text-book on the strength of materials. Mr. Williams' chief responsibility on the staff of the Engineering Record will be for articles on structural subjects.

Henry D. Hammond, formerly with the Foundation Company of New York, has been appointed associate editor of the Engineering Record. With the exception of a short period spent as draftsman in the Brooklyn office of the American Bridge Company, he has been with the Foundation Company since his graduation at Yale in 1909. He received the degree of bachelor of arts that year, having in the previous year completed the civil engineering course in Sheffield Scientific School. His work with the Foundation Company has embraced practically every phase of difficult foundation and shaft work, and in almost every capacity from machinist and blacksmith helper to superintendent of important work. His first experience was on shafts sunk as pneumatic caissons in the Minnesota-Michigan mining district. Subsequently he served as assistant to the western manager of the company, with office in Chicago; as engineer on building foundations in St. Louis and New York; as assistant superintendent on the piers of the new bridge for the Union Pacific across the Kaw, and as general foreman of the very important construction operations on the Pennsylvania's new bridge over the Muskingum River in Ohio. At the time of his resignation to come with this journal he was assistant superintendent on Government Lock and Dam 12 on the Ohio River. He will devote his attention on the Engineering Record chiefly to construction plant and methods.

Obituary Notes

Frank Felkel died in Pittsburgh, Feb. 25. He was engaged in engineering work in Pittsburgh for the past 25 yr. and was a member of the Mississippi River Commission, 1878-1890.

Louis V. Stiernberg, a civil engineer and resident of Chicago for the past 40 yr., died in that city, Feb. 25. Mr. Stiernberg had much to do with planning the Chicago park systems and for several years was connected with the Chicago Sanitary District.

Civil Service Examinations

Chicago.—The Civil Service Commission will hold an examination for the position of senior layout engineer, salary $1920-$2400, March 9.

Examinations Previously Announced

Date		See Eng. Record
March 10	—Aid Coast and Geodetic Survey; computer, Coast and Geodetic Survey; copyist topographic draftsman, departmental service; junior engineer draftsman; topographic draftsman; surveyor, Philippine service; superintendent of construction, supervising architect's office; United States.......	Feb. 6
April 14	—Civil engineer and draftsman; copyist draftsman, Navy Department; mechanical draftsman, Panama Canal Service; ship draftsman, Navy Department; topographic draftsman, Panama Canal Service; engineer, Indian Service; United States...	Feb. 6
March 12	—Bridge designing draftsman, Chicago	Feb. 27

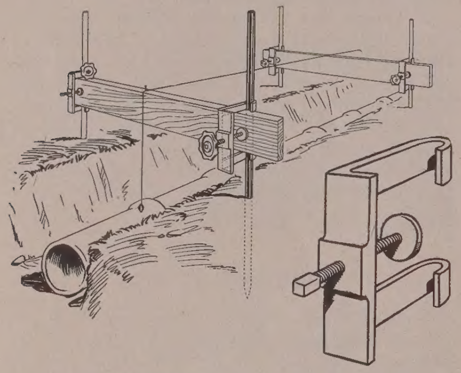
Exhibit of Road Materials Feature of Wisconsin Exposition

An exhibit of road materials will be a feature of the University of Wisconsin Exposition, March 19 and 20. The exhibit is being prepared under the direction of Prof. L. S. Smith, of the college of engineering, who asserts that Wisconsin's wealth of natural good road materials is more valuable than the gold and silver in all the mines of Colorado and California. Specimens of different roads and pavements built in the cities of Wisconsin will be displayed. The object of the exhibit is to arouse the farmers of the State to an appreciation of the material advantages they would derive from highway improvements.

New Clamp to Hold Grade Boards on Sewer Work

A new form of grade board clamp device, for which patents are pending, is shown in the accompanying illustration. It is intended for sewer work and consists of a galvanized clamp, a board of any length and up to 2 in. thick, and two 1-in. iron rods.

The following advantages to be gained from the use of this device are claimed by its designer, Russell H. Peck, 855 Riverside Drive, New York City:



GRADE BOARD CLAMP ON SEWER WORK

Grade boards may be quickly and easily set up and accurate lines and grades are assured; the boards can be adjusted to any height or span; the iron rods drive easily in hard or frozen ground and even pipe or old reinforcing rods can be utilized; the clamps are galvanized to protect them from rust and can be tightened fast against the rods.

Business Notes

W. J. Rosebery, Jr., sales manager of the concrete mixer department of the Power & Mining Machinery Company, Cudahy, Wis., died Feb. 27.

The Troy Wagon Works Company's Philadelphia representative is J. L. Keir; his name given in last week's issue as J. L. Keis was misspelled. Mr. Keir's offices will be in the Abbot Building.

The Schaeffer & Budenberg Mfg. Company, of Brooklyn, N. Y., manufacturers of gauges and recording devices, have just moved into a new seven-story reinforced-concrete factory building at Berry and South Fifth Streets, giving them a floor area of 70,000 sq. ft.

William Powell Company, of Cincinnati, Ohio, has marketed a new valve called "Irenew," which is composed of renewable parts, a feature, it is asserted, that makes the valve applicable for variations of use with most temperatures of superheated steam or cyanide solutions. The arrangement consists of a disc and seat ring fitted to facilitate dismantling.

The Lea-Courtenay Company, manufacturers of high-duty turbine pumping machinery, announces that, owing to an increase in the business, it has been found advisable to open a branch in Chicago. This business has been handled by Maher & Byrne. Mr. Maher, who has resigned from this company, will be Chicago manager for the Lea-Courtenay Company and will have offices in the Conway Building.

Trade Publications

The following companies have recently issued trade publications:

Eureka Machine Company, Lansing, Mich. Circular descriptive of the Eureka mixer for 1915.

Connersville Blower Company, Connersville, Ind. Catalog 16, 48 pages, 9 x 12 in. Two-impeller cycloidal rotary pumps.

Union Iron Works, Lackawanna Siding, Hoboken, N. J. Bulletin 24, 3½ x 6¼ in. Data on pile hammers.

Neil & Smith Electric Tool Co., Cincinnati. Illustrated folding leaflet describing Type F 1 Ideal portable electric center grinders.

Sauerman Bros., Monadnock Block, Chicago, Ill. Folder, 8½ x 11 in., illustrated. Sauerman type A patented drag-line cableway excavator.

Bullock Tractor Company, Inc., 1801 Diversey Parkway, Chicago. Catalog, 6 x 9 in., illustrated, describing the "Creeping Grip" tractor.

United Lead Company, 111 Broadway, New York City. Folder, 4 pages, describes Ulco lead wool in its application to laying cast-iron pipe. Illustrated.

Chicago Pneumatic Tool Company, Fisher Building, Chicago. Bulletin 34-S, November, 1914, 6 x 9 in., describing and illustrating small power-driven compressors.

Walter A. Zelnicker Supply Company, St. Louis, Mo. Folder 3 x 6 in., illustrated. Concise description on Hancock inspirators supplemented with price list tables.

Imperial Brass Manufacturing Company, Chicago. Catalog 111, 6¾ x 9¾ in., 20 pages, illustrated. Describes oxy-acetylene apparatus for welding in shop or field work.

Yorke Derrick Company, Washington, Pa. Catalog, 5½ x 7¾ in., 32 pages, illustrated. Structural steel concreting towers, automatic dump buckets, hoppers and spouts.

Jaeger Machine Co., Columbus, Ohio. Catalog, 6¼ x 9¼ in., 32 pages, illustrated. Describes concrete mixers for general purposes and for building and pavement work.

Western Paving Brick Manufacturers' Association, Kansas City, Mo. Pamphlet, 5 x 6 in., describes No. 1 vitrified vertical fiber paving block as standardized by this association.

Waterloo Cement Machinery Corporation, Waterloo, Iowa. Catalog, 6 x 9 in., 40 pages, illustrated. Construction of Little Wonder "Five" and Wonder "Ten" concrete mixers.

Sandusky Portland Cement Company, Sandusky, Ohio. A 32-page descriptive and illustrated booklet devoted to Medusa waterproofing and structures in which it has been used.

Stow Mfg. Co., Binghamton, N. Y. Bulletin 54, 6 x 9 in., 4 pages, illustrated. Describes small electrically driven flexible shaft tools, such as a general utility tool and a two-spindle drill.

George Haiss Mfg. Co., Inc., 142d Street and Rider Avenue, New York City. Illustrated 8-page bulletin, No. 1014. Use and recent services of Haiss clamshell buckets and equipment.

United States Asphalt Refining Co., 90 West Street, New York. Illustrated, 8-page pamphlet describing Aztec road surfacing asphalt and its use for worn out and raveled macadam roads.

Standard Asphalt and Rubber Co., 208 La Salle Street, Chicago. Folder describes briefly Sarco 6 mineral rubber for waterproofing floors and roofs, as well as Plastite roof coating material.

Amies Road Company, Easton, Pa. Booklet, 8 x 5½ in., 44 pages, illustrated. Shows examples of highway construction of Amiesite pavement cost compared to other forms of construction.

National Pipe Company, Pittsburgh. "National" Bulletin 12-C, 8½ x 11 in., 16 pages, illustrated. Characteristics of National pipe. Tables and lists incidentally inserted add important facts.

John F. Byers Machine Co., Ravenna, Ohio. Catalog 21, 9¼ x 12¼ in., 68 pages, illustrated. Main points of construction, size, adaptability and appurtenances of Byers hoisting engines and equipment.

Edward R. Bacon Company, 51 Minna Street, San Francisco, Cal. Descriptive illustrated leaflet (Bulletin 10) of Wallace concrete and lumber hoists, Wallace hoppers and gates, wheelbarrows and friction-drum hoist.

Van Wie Pump Company, Syracuse, N. Y. Bulletin 300, 7¾ x 10 in., 8 pages, illustrated. Contains a brief treatment of gasoline motor-drawn centrifugal pumps for contracting, municipal engineering, railroad and irrigation work.

Buffalo Forge Company, Buffalo, N. Y. Catalog 201, 6 x 9 in., 64 pages, illustrated. Deals with the Niagara Conoidal fan, type N. Tables dealing with efficiency, horsepower, velocity and capacity make up a considerable part of the text.

Keystone Driller Co., Beaver Falls, Pa. Methods of drilling, spacing, loading and shooting big blast holes, and a compilation of articles by engineers, contractors and quarry superintendents. Numerous illustrations and tables of cost data.

Buffalo Meter Company, Buffalo, N. Y. Pamphlet, 8¼ x 10½ in., 12 pages. Treatise explaining elements of a meter rate and how to establish rates. There is given a valuable table showing the high and low rates for 709 waterworks and a suggested model for meter regulations.

The Eureka Machine Company, Lansing, Mich., illustrated circular, 6 x 9 in., 4 pages. Describes new Eureka batch mixer No. 5 recently developed. This mixer, mounted on a four-wheel truck, has power loader, automatic measuring tank, either gasoline or electric drive and other standard Eureka features.

Cable Excavator Company, Commercial Trust Building, Philadelphia. Catalog, 7 x 10 in., 40 pages, illustrated. Gives special attention to Hadsel patented slack-cable excavator among other types of excavating and earth-handling machinery, and describes its use on engineering work.

Epping-Carpenter Pump Co., Pittsburgh. Bulletins 102, 103, 104, 105, 106 and 109, bound, 11¼ x 8¾ x 1¼ in., illustrated. Description and data relating to piston pumps, center packed plunger pumps, end packed pot valve pumps, boiler feed pumps, hydraulic pressure pumps, accumulators and centrifugal pumps make this volume a valuable reference on pumping machinery.

Cambria Steel Company, Johnstown, Pa. Catalog, 9 x 6 in., 41 pages, illustrated with photographs and drawings. Introduces the Slick steel mine ties for mine and industrial railroads, mentioning advantages of the steel over the wooden tie. For instance, it is stated that a 15-ft. section of Slick tie track with 16-lb. rails can be lifted and carried by two men; a medium-weight tie weighs 10 lb. and a light-weight tie, 5 lb.

Charles T. Main, 201 Devonshire Street, Boston. Booklet, 9 x 7½ in., 62 pages, illustrated, entitled "Industrial Plants, Vol. 2." Describes a number of buildings which have been erected during the past 4 yr. under the supervision of this organization, and several developments either completed or under construction, the most noteworthy of which are the Great Falls development on the Missouri River and the Thompson Falls on the Clark Fork of the Columbia River. The booklet is arranged with good taste.